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THE EXHALATION OF OZONE BY FLOWERING  
PLANTS.

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**T**HAN ozone there is, perhaps, no more highly remarkable and perplexing substance. Nevertheless there is no substance more important to the sanitarian for study and consideration, since it has undoubted hygienic bearings, some of which are now quite well understood. There is no question but that through its oxydizing properties it is the greatest natural purifier of the atmosphere.

It is doubtless nature's means of ridding our atmosphere of organic impurities, and disease germs, which cause, as is well known, manifold forms of suffering, and render the air unfit for breathing purposes.

We have little certain knowledge of its real nature and many of its properties; and leaving the solution of these more puzzling questions to the expert chemist, I purpose to adduce evidence with a view of establishing a newly-discovered source in nature of this important substance.

Ozone can be artificially formed in various ways, to wit: by passing electric discharges through pure oxygen; by the electrolytic decomposition of water; by suspending a stick of phosphorus in a bottle filled with moist air, and in other ways. It is present in the atmosphere, but not universally. Fresh, pure atmosphere generally contains ozone, while it is absent from the close air of cities and occupied dwellings, for the reason that in the latter places it is consumed in oxydizing and destroying organic impurities. For a like reason it is frequently found in the air to the windward of a city, but rarely or never to the leeward.

In my readings, while preparing earlier memoirs on some plant functions, I would not infrequently meet with statements to the effect that some sort of relationship exists between vegetation, and particularly forest growth, and the ozonic condition of the atmosphere. Thus, as stated in a former paper, a Dr. Schreiber maintains that the emanations from pine forests actively convert the oxygen of the air into ozone, but upon what basis of truth, if any, the statement rests, I have not learned. A. Naquet says, "Ozone exists in woods and fields and wherever there is active vegetation." It is evident that assertions of a general character like the above, without experimental proof, are of no real scientific value. On the other hand, the solution of so important a question as whether plants generate or convert the oxygen of the air into ozone, could not fail to be hailed as a noteworthy advance in scientific knowledge.

For more than a year past the writer, while engaged in the active practice of his profession, has devoted his intervals of leisure to an experimental investigation of the subject. Preliminary to giving in detail the results of these experiments, it is thought proper to speak of the various tests for the detection of ozone, and to point out the relative merits of the same. As indicative of the difficulties of making such tests, numerous ozonoscopes have from time to time been devised, most of which have proved highly unsatisfactory.

Dr. A. R. Leeds, of Stevens Institute of Technology, has made an investigation into the relative merits of some half dozen leading tests for ozone (*Chem. News* for May, 1878). Without giving a detailed account of his observations, it will suffice our purpose to state a few of his conclusions. The Schoenbein or oxydized starch test was found to be most sensitive. It may be here stated that this test was used in all my observations. Of the guaiacum test, which was also employed in our experiments, Dr. Leeds remarks, "Guaiacum papers were only moderately sensitive, acquiring speedily, when dry, a faint blue color, and when moistened occupying a position midway between the ozonoscopes most sensitive, and those least so to the influence of ozone."

In the National Board of Health Bulletin (for March, 1882), Dr. J. H. Long, under the auspices of the American Medical Association, records the results of ozone observations made in different places throughout the United States, by a number of gentle-

men who kindly coöperated with him. In these investigations three kinds of tests were employed, to wit: Schoenbein paper, paper impregnated with tincture of guaiacum, and paper impregnated with solution of thallous hydrate. The doctor gives the methods of preparing these different papers. The Schoenbein is made according to the following formula: Potassium iodide 5 parts, starch 50 parts and water 1000 parts. The starch and iodide are rubbed with a small amount of water until a milky homogeneous fluid is produced, and then the rest of the water is added and the whole boiled for some time with constant stirring. The freshly prepared paste is spread on strips of filter paper, which are afterwards dried in a close room. The filter paper used is the best Swedish (Munktells). The guaiacum is made from a carefully prepared tincture containing 8 per cent of resin and 90 per cent of alcohol. When exposed to artificially prepared ozone this paper turns greenish-blue and finally a bright blue, while the Schoenbein turns quite blue. The papers employed in the present researches were very kindly prepared for me by Professor Henry Leffman after the above formulæ, and they gave excellent reactions both in the hands of the professor and in my own hands, when exposed to ozone artificially prepared. The iodized starch, or Schoenbein, being universally acknowledged to be the most sensitive, as well as giving the most reliable results, the reactions obtained by this test were considered of paramount importance and value. There are, however, sometimes other bodies present in the atmosphere which have the power of decomposing iodide of potassium, and hence give a blue reaction as well as ozone, to wit, peroxide of hydrogen, the oxides of nitrogen and ammonia. The latter substance can be detected by suspending a piece of red litmus near to the test papers, the effect being to turn the paper blue. The presence of the nitrous oxides can also be readily demonstrated. How to avoid mistaking the reaction of peroxide of hydrogen for ozone may prove difficult, since the two substances appear to have many properties in common. Indeed, it has been a disputed question among chemists whether it is possible to distinguish between them by any known tests. Professor A. R. Leeds (*Chem. News* for April 9, 1880) claims to be able to recognize each by its own properties. He continues, "The most striking property of ozone is its smell. This smell, so far as long continued familiarity with it enables me

to judge, whether the ozone is derived from the silent discharges of pure and dry oxygen, or accompanies the electrolysis of water (and the smell is identical), is possessed by ozone only." This odor is not peculiar to peroxide of hydrogen, for the same author says of this substance, "The solution which I have prepared at different times myself, carbonic acid being employed to decompose barium peroxide, have not evolved any odor that I was able to recognize or perceive. Ozone is only slightly soluble in water, and is readily expelled on heating, while hydrogen peroxide is mixable, and solutions containing one per cent of peroxide of hydrogen may be concentrated by evaporation on the water bath until a higher degree of concentration is reached without great loss of peroxide."<sup>1</sup>

The question, can ozone and peroxide of hydrogen coëxist in the same atmosphere? has also been oppositely discussed by chemists. Professor McLeod, as the result of his investigations (*Chem. News*, Vol. XL, p. 307), concluded that these two bodies decompose one another. From this fact he further argues that it is extremely improbable that ozone and peroxide of hydrogen are both formed during the slow oxydation of phosphorus. On the other hand Schöne, by an elaborate series of experiments (quoted by Leeds) shows that when strongly oxydized oxygen, containing 5.2 volumes per cent of ozone, is agitated with an hydrogen peroxide solution containing 0.4 per cent of the peroxide, or three or four times as much as is necessary to destroy all the ozone, it is only after the lapse of half an hour that as much as half of the ozone is destroyed. Professor Leeds, in the article already referred to, comes to the rescue of Schöne, and very conclusively shows that not only ozone but also peroxide of hydrogen are formed during the slow oxydation of phosphorus, and that those two substances can and frequently do coëxist, the absolute quantity depending upon the temperature, the length of time they remain in contact with one another, etc., though it is true that a slow, mutual decomposition takes place when together. According to all the best authorities, peroxide of hydrogen decomposes at a temperature of about 70° Fahr., while to destroy ozone requires a temperature of about 200° Fahr. The importance of this fact cannot be overrated, as it has a great bearing upon the results of the present experiments.

<sup>1</sup> See also Schöne, *Ann. der Chem.*, 196, p. 60, and Davis, *Chem. News*, Vol. XXIV, p. 221.

In the case of the guaiacum test there are so many interfering conditions as to render it nearly valueless. Thus it will not only react in the presence of peroxide of hydrogen and the oxides of nitrogen, but even the oxygen of the atmosphere is said to impart to it a tint hard to distinguish from the coloration due to ozone.

The color scales were not used in these researches, as they are very difficult to obtain and, furthermore, the object here was not so much to ascertain the degree of coloring of the test papers as the single important fact whether plants have the power of generating ozone.

In noting the results obtained, the terms "marked," "slight" and "very slight" are used to express, in a general way, the extent of blue coloration. This plan is deemed preferable for the reason that the tints, in most instances, were not very striking.

My first observations were conducted in Horticultural Hall, Fairmount Park, Philadelphia. It was thought that a careful testing of the air of this hall, filled as it is with a profusion of plants, mostly of the foliage varieties, would give results sufficiently striking to be of value in clearing up the subject. In this, however, I was measurably disappointed, as will be seen hereafter. The hall has several compartments. The so-called main hall, of about the following dimensions: 220 feet in length, 100 feet in width and, the dome-like roof being of glass in the center, 65 feet high. The room is filled with a variety of species of palms, bananas, monesteras, colocasias, caladiums, ferns, *Ficus elastica*, bamboo canes, Australian and New Zealand pines and numbers of smaller foliage plants. Average temperature of the hall during the time of experiments, 70° Fahr.

On either side of the main hall are several smaller ones in which the air was likewise tested, known under the names fern house, forcing house, temperate house, propagating house and economic house. The dimensions of these rooms are, length 100 feet, width 30 feet, ceiling, curvilinear and of glass, 20 feet in height. The temperate house contained half hardy plants, as the orange, lemon, hibiscus, and a number of azalias in bloom. The forcing house contained bedding plants, geranium, colius and achyranthes, but few blooming, mostly cuttings. Economic house contained pitcher plants, tea, coffee, chocolate, sugar, yapas, cinchona and aromatic plants. Propagating house is located outside of the main building, and contained geraniums in bloom. The fern house was well stocked with ferns.

The average temperature of these apartments was as follows: Economic house 80°, temperate house 55°, fern house 65°, forcing house 75° Fahr.

The first experiments were commenced Oct. 14, 1882, and continued till the end of November. The atmosphere of the main hall was tested on twenty-five days during this period, the Schoenbein giving negative results except on Nov. 29th and 30th, when this paper showed a slight blue tint. The papers were placed on the branches of the highest plants, moistened both when they were suspended and after being taken down, and the duration of the experiments varied from four to twenty-four hours.

The guaiacum test paper showed a very slight reaction for about one-half of these observations, but unfortunately this test could not be relied upon, while the results with the Schoenbein were too meager on which to base conclusions. A few tests were made during this series simultaneously in the forcing and fern houses with negative results. It should be stated that these experiments were being conducted at a time when numerous visitors were daily attracted to the hall by the indescribable beauty of the plants, and hence it was thought not unreasonable to suppose that any ozone which might have been generated by the plants was consumed in oxydizing the organic matter given to the air by the visitors, for it should be remembered that, as Pettenkofer has pointed out, ozone is never detectable in the atmosphere of occupied dwellings. Though these experiments were barren of results, when the above circumstances are taken into account they were not much to be wondered at.

The next series of observations began in the latter part of February, and were continued through the months of March and April of the past year. During the month of February there was only an occasional visitor admitted, in March there were likewise very few, while in April the number was considerably greater, though not by any means numerous. These experiments yielded results somewhat more encouraging. The atmosphere on the exterior was simultaneously tested for the sake of comparison in the two situations. The observations were taken for fourteen days in the main hall, Schoenbein papers being used, and five of these gave "very slight" reactions, while the outer air gave during the same time six "very slight" reactions and one "slight." Twenty-four tests of the air in the temperate house with the

Schoenbein gave only three "very slight" reactions. During these observations the outer air was tested twelve times, with but two "slight" reactions, and the air of the propagating house for the remaining days in place of the outer air, which gave two "very slight" reactions. The air of the propagating house was next compared with the external air. For thirteen days in the former situation the Schoenbein paper gave "very slight" reactions in four instances, while the latter (outer air) gave "very slight" indications of ozone in two instances. It will be observed that here the result was better in the propagating house than in the open air, which was, to say the least, quite suggestive. In all the preceding experiments of this series there was a striking similarity in the two situations, and the outer air giving somewhat the better results. The air of the fern house, as well as economic house, were also given a few trials and compared with the outer air, but the results were negative throughout. During all of the outdoor observations the guaiacum paper gave slight indications of ozone in more than half of the experiments, and striking in four cases. The results with this paper for corresponding days indoors were almost identical, with the degree of coloring in a few instances in favor of the outside. The propagating house yielded the best indoor results with the guaiacum paper, as did the Schoenbein, while the temperate house gave almost equally good results with the guaiacum paper as in the propagating house. This was not the case, it will be remembered, with the Schoenbein. The duration of the individual experiments varied from six to sixteen hours, the average duration being about ten hours.

The question here arises, were the reactions obtained by the indoor tests due to ozone emitted from the plants or to the circulation of the outer air through these apartments. There is constantly more or less interchange of air between the exterior and interior of the building, due to the numerous interstices between the panes of glass and the frequent opening and closing of the doors. It must also be observed that all these apartments are heated (and artificial heat was necessary during all these investigations) by numerous hot water pipes placed directly under and parallel with a grated floor from which warm air rises and ascends through the building. The idea that the external conditions might have affected the results on the inside is doubtless still further strengthened by the fact that most of the results obtained

were, as already stated, nearly identical in the two situations, with a preponderance of coloring in favor of the outside. I was thus forced, though reluctantly, to dismiss all the experiments thus far made as having yielded doubtful results, excepting those made in the propagating house, of which it will be necessary to speak further.<sup>1</sup>

How can we account for the results in this situation differing from those of the other rooms? I was unable at that time to find any good reason, the conditions appearing to be about the same. Subsequent experimentation, however, threw new light upon this vexed question. It will be only necessary here to state, what I trust will be evident to the mind of the reader later on, that the somewhat more striking results in this house must have been due to the fact that it was well stocked with flowering geraniums.

*(To be continued.)*

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## THE CREODONTA.

BY E. D. COPE.

*(Continued from the March number, p. 267.)*

### HYÆNODONTIDÆ.

IN this family the anterior cusp of the inferior true molars is so developed as to form, with the median cusp, a true sectorial blade. The posterior cusp is rudimental, and in the last inferior molar wanting. There is no internal tubercle. In the superior molars, on the contrary, the anterior basal cusp has disappeared, and the posterior one is developed behind the middle one, like a blade. The superior molars, like the inferior, have no internal lobe.

Professor W. B. Scott has studied the posterior limb and the brain-case of a species of *Hyænodon*, which he describes as follows. I quote from the advance sheets of his paper on this subject, which he has kindly permitted me to use:

"The hind limb is in essentials very like that of *Mesonyx* of the Bridger Eocene; the femur has a decided third trochanter. The tibia is much like that of *Mesonyx*, and its distal end is characteristically Creodont in having its astragalus face almost

<sup>1</sup> My acknowledgments are due Mr. Menje for valuable assistance while conducting these observations.

flat, with only a very slight median ridge for the groove of the astragalus. The internal malleolus is very large.

"The astragalus is but slightly concave from side to side, much less so than in *Mesonyx*.

"The foot is plantigrade, and the entire length of the calcaneum rested on the ground. Five well-developed digits were present, terminating in short and stout compressed claws; very different from the peculiar depressed ungual phalanges of *Mesonyx*; otherwise the resemblance of the foot as a whole to that of *Mesonyx* is very striking.

"The brain case attributed by Gervais to *Hyænodon* must belong to some other genus, or else our American species differ very radically from the French. In the American species the brain is relatively very small and simple, being but slightly larger than that of *Thylacynus*, to which animal *Hyænodon* presents many interesting approximations in the structure of the skull and teeth. The cerebellum of *Hyænodon* is entirely uncovered by the hemispheres, which in their turn seem to have but three straight longitudinal gyri, presenting the simplest type of the carnivorous brain."

It is highly probable that this family is a derivative of a pentadactyl form of the *Mesonychidæ*. Its appearance in time corresponds nearly with the disappearance of the latter.

But one genus of this family has been thus far described, the *Hyænodon* of Laizer and Parieu. Its dental formula is I.  $\frac{3}{3}$ ; C.  $\frac{1}{1}$ ; P-m.  $\frac{3}{3}$ ; M.  $\frac{3}{3}$ . The last three molars in both jaws are sectorials, and the last of these are the largest, and form the most effective shears for the dividing of animal tissues. The position of these teeth indicates a mouth fissured far posteriorly, and a correspondingly posterior position of the masseter muscle. This structure indicates a weak power of prehension of the canine teeth. This character is sustained by the frequently anteriorly directed inferior canines, and the generally slender mandibular rami. The *Hyænodons* must be regarded as snappers, and not capable of holding on to a living enemy with much persistency.<sup>1</sup> They were evidently weaker in all points of organism than the modern Carnivora, which no doubt accounts for their extinction. Thirteen species have been described, all but three North American forms being French. The oldest of these, the *H. parisiensis* Kefst., is from the Upper Eocene or Oligocene, or the Paris Gypsum, but its reference to this genus is not yet certain. Gaudry, however,

<sup>1</sup> See On the origin of the sectorial tooth of the Carnivora, AMERICAN NATURALIST, 1876, p. 171.

states that *Hyænodon* occurs in the Gypse. Seven species are described by Filhol as from the Phosphorites. Some of these (as *H. leptorhynchus* L. & P.) are elsewhere found in the Stam-

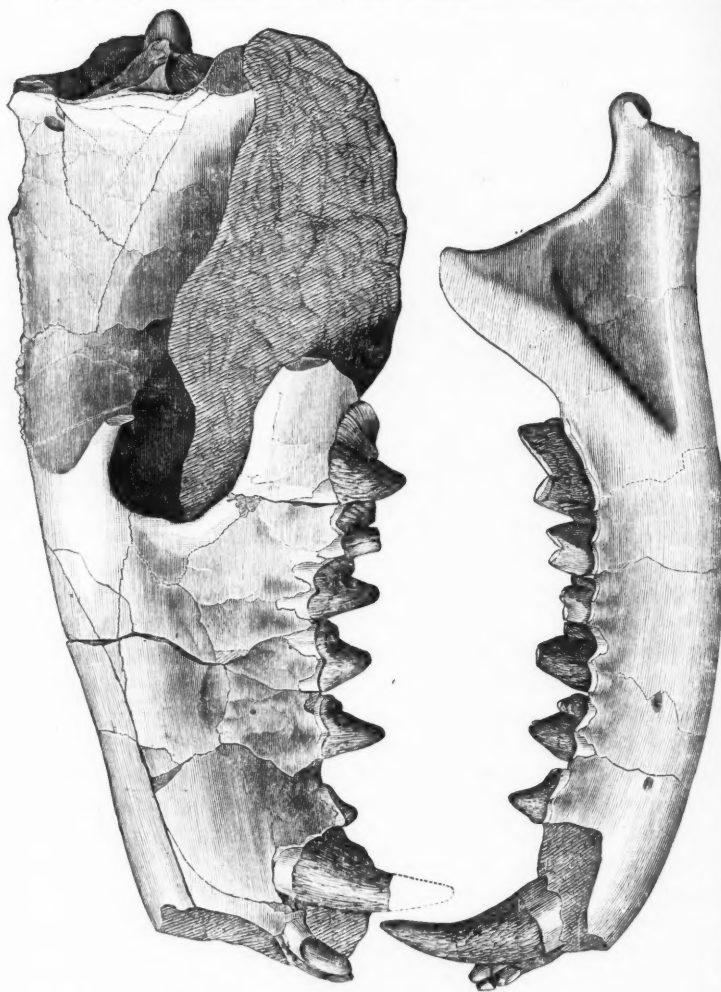


FIG. 12.—*Hyænodon horridus* Leidy, skull one-half natural size, From the White River formation of Nebraska, From Leidy's Extinct Mammalia of Dakota and Nebraska,

pian, a Lower Miocene, but some of them are probably Upper Eocene.<sup>1</sup> The three North American species are from the White

<sup>1</sup> Professor Gaudry thinks the Phosphorites include fossils of different Tertiary epochs.

River or Oligocene horizon, and no species is known from later formations. The species range in size from that of the *H. vulpinus* Gerv., which equals a red fox, to that of an American black bear, as the *H. heberti* Filhol, and *H. horridus* Leidy (Fig. 12). The latter species is from the bad lands of Nebraska.

#### LEPTICTIDÆ.<sup>1</sup>

This family is very nearly related to the Centetidæ, which are now living in Madagascar. The only character by which I dis-

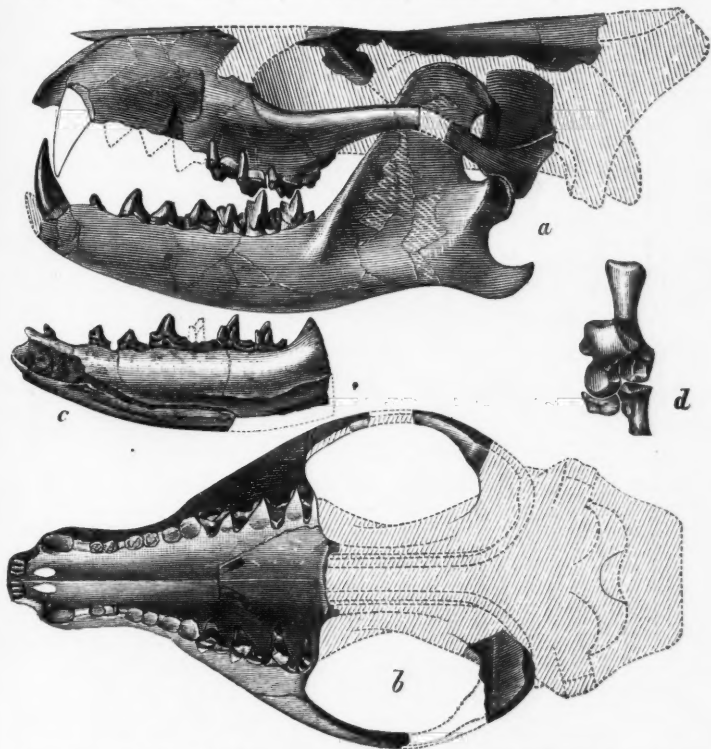


FIG. 13.—*Styolophus whitii* Cope, skull and part of posterior foot of two individuals, two thirds natural size. Figs. *a-b* from the Wasatch beds of the Big Horn river, Wyo. Figs. *c-d* from the basin of the Wind river, Wyo. Fig. *c*, internal side of part of right mandibular ramus. Fig. *d*, left tarsus minus cuneiform bones, from above. Original, from Vol. III, Report U. S. Geological Survey Terrs., F. V. Hayden.

tinguish it is by the presence of the zygomatic arch, a part of the skull which is absent in the Centetidæ (Fig. 13). The Leptictidæ

<sup>1</sup> This family is included in the Centetidæ in the first part of this paper, p. 261.

are no doubt the ancestors of the Centetidæ; and their later types, as Leptictis, approach the existing family in their dentition quite closely.<sup>1</sup> The earlier types display great variety in their dentition, and give ground for distinguishing many genera.

Two groups are easily recognized among the Leptictidæ. In the first of these the last or fourth inferior premolar is a simple premolariform tooth, different from the inferior true molars, and without any internal cusp. In the second division the fourth inferior premolar is either like the true molars or approximates their form by the presence of an internal tubercle. To the latter group belongs the genus *Chriacus*, which from the slight development of the fourth inferior premolar (Fig. 14) approximates the first division. The genus may, however, be improperly referred to the Creodonta.

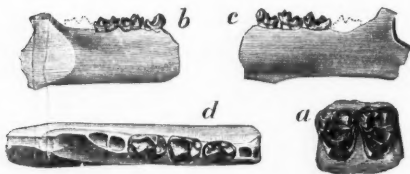


Fig. 14.

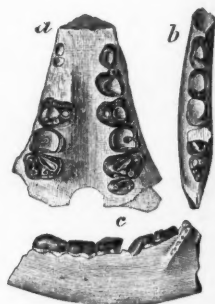


Fig. 15.

FIG. 14.—*Chriacus angulatus* Cope, right ramus of mandible and part of maxillary bone with teeth; from the Wasatch beds of the Big Horn, Wyoming. Figs. *a* and *d* twice natural size. Figs. *b*–*c* natural size. FIG. 15.—*Miochenus turgidus* Cope, part of skull and lower jaw of one animal, two-thirds natural size. From the Puerco beds of New Mexico. Original, from Vol. III, Report U. S. Geol. Survey Terrs.

There are seven genera of the first division of the family. These may be distinguished into two sections. In one of these there are three well-developed anterior cusps of the inferior true molars, forming a tubercular sectorial tooth; in the other the anterior

<sup>1</sup> Enough is now known of the mammalian fauna of Madagascar to convince us of its decidedly Miocene and, to some degree, Eocene character. The lemurs and Centetidæ approximate nearly the Eocene types; the *Chiromys* is near the Eocene *Tilodonta*, while the closest allies of the carnivorous genus *Cryptoprocta* are found in the Lower Miocene of France and the Middle Miocene of Oregon. The Oligocene descendants of the Eocene types appear to have persisted in Madagascar. The reptiles are not African but are South American.

cuspid is rudimental or wanting, and the tooth approximates more or less the quadrituberculate condition. In the latter subsection there are three genera. The first of these, *Mioclænus* Cope, has the inferior true molars quadrituberculate and of equal elevation; the first true molar may have an anterior or fifth tubercle. The external cusps of the superior true molars are distinct and conical. In *Triisodon* Cope, the inferior true molars only are known. These have four cusps with a rudimental anterior fifth. They differ from the corresponding cusps in all the other genera in being compressed so as to have fore and aft cutting edges. *Diacodon* Cope, is the third genus. Its superior molars are like those of *Mioclænus*, but the two anterior cusps of the lower true molars are much elevated, the posterior are rudimental, and there is a rudimental fifth in front.

*Mioclænus* presents the only truly quadritubercular lower molars in the suborder. It is so far known only from the Puerco or oldest Eocene of North America. There are nine species known

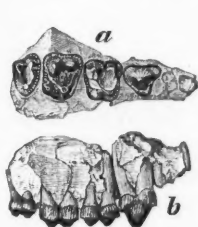


Fig. 16.

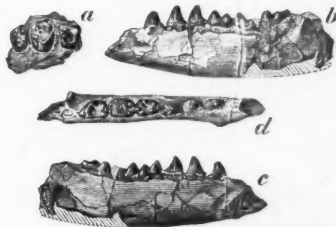


Fig. 17.

FIG. 16.—*Mioclænus corrugatus* Cope, last four molars on maxillary bone from below, two-thirds natural size. From the Puerco beds of New Mexico. Fig. a, from below; b, from right side. FIG. 17.—*Mioclænus subtrigonus* Cope, parts of maxillary and mandibular bones two-thirds natural size; from the Puerco beds of New Mexico; a, superior true molar teeth from below; b, left mandibular ramus, external side; c, do. inner side; d, from above. From Report U. S. Geol. Survey Terrs., Vol. III.

so far, which range from the size of a mink (*M. minimus*) to that of a wolf (*M. ferox*) in the sizes of their jaws, but in the case of the *M. ferox*, of which a good deal of the skeleton is known, the body was relatively smaller. The species differ in the form of the third superior premolar, and in the robustness of their inferior premolars. The *M. turgidus* (Fig. 15) represents the type with robust premolars, and the *M. subtrigonus* (Fig. 17) those with more compressed premolars.

We can read the nature of the primitive mammal, *Miocænus terox*, in so far as the materials permit. It was an effective flesh-eater, and probably an eater of other things than flesh. It had a long tail and well-developed limbs. It had five toes all around, and the great or first toe was not opposable to the others, and may have been rudimental. The feet were plantigrade and the claws prehensile. The fore feet were well turned outwards. There were, perhaps, marsupial bones, but this point is not yet certainly determined. The presence of a patella distinguishes it from marsupials in general. Its embracing glenoid cavity of the skull, and form of the inferior molars, resemble those of the *Arctocyonidæ*.

This species is about the size of a sheep. The bones are stated by Mr. Baldwin, who discovered it, to be derived from the red beds in the upper part of the Puerco series.

The genus *Triisodon* includes as yet but one species, the *T. quivirensis* Cope, which is only known from the rami of the lower jaw. These bones are shorter and more robust than those of the coyote, and indicate an animal of perhaps the size of the wolverine (Fig. 1, p. 257). It was evidently strongly carnivorous in its diet, and was a capable biter. Its remains are from the Puerco of New Mexico.

*Diacodon* includes seven species, two from the Wasatch Eocene, the others from the Puerco. The former are much the smaller (Fig. 18), while those of the Puerco vary in dimensions from the size of a common weasel (*D. assurgens*) to that of a wolf (*D. conidens*). The five species of the Puerco were formerly referred by me to the genus *Triisodon*, but are now more properly placed in *Diacodon*. The only species in which the superior molars are known is the *D. conidens*, where they are generally identical with those of *Miocænus*.

Of the four genera of the first division of the *Leptictidæ*, which possesses tubercular sectorial teeth, but two are found in North America, while three of them have been discovered in Europe.

The typical and most widely distributed genus is *Stypolophus*

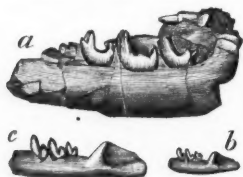


FIG. 18.—Jaws of species of *Diacodon* from the Wasatch bed of New Mexico. Fig. *a*, *Diacodon alticuspis* Cope, right mandibular ramus, inner side, twice natural size. Fig. *b*, *D. celatus*, left mandibular ramus, natural size; *c*, same, twice natural size. Original, from the Report U. S. G. G. Surv. W. of 100th mer., G. M. Wheeler.

Cope (Fig. 13). It has compressed premolars, except the fourth superior, which is conic with two basal lobes. In *Proviverra* Rütimeyer, this tooth is triangular and cutting. One species has been found in the Swiss Eocene. *Quercitherium* of Filhol is distinguished by its very robust premolars. Like *Proviverra* it has but one rather small species. It is from the French Phosphorites. *Stypolophus* has the two cusps of the superior true molars close together, forming twin cusps, and they have behind them a heel, which is cutting. Two species have been discovered in the French Phosphorites, one of which, the *S. caylusi* of Filhol, is preserved to us in the most perfect skull of a Creodont known. From it I have restored the skull of the *S. whitæ* (Fig. 13). It has elevated sagittal and posterior crests for the insertion of the temporal muscles, and the brain-case is very small. A cast of the brain displayed to Mr. Filhol the following characters: The hemispheres are small, and leave the cerebellum and the posterior edge of the middle brain uncovered. Anteriorly they contract to an isthmus which separates them from the large olfactory lobes. The hemispheres display three longitudinal convolutions, and very little indication of sylvian fissure. Of the American species, five are known from the Wasatch, and four from the Bridger beds.

Nearly allied to *Stypolophus* is the genus *Didelphodus* Cope, which only differs from it in the possession of but three superior premolars. The single species, *D. absarokæ* Cope, is about the size of a skunk, and has been obtained in the Wasatch Eocene beds of the Big Horn river, Wyoming (Fig. 19).

There are six genera of the second section of the family Leptictidæ, *i. e.*, those with the fourth inferior premolar more or less like the true molars. In five of these genera the canines and incisors have the proportions usual in carnivorous animals, but in the sixth, *Esthonyx* Cope, the canines are smaller than some of the incisors.

In this respect *Esthonyx* esembles some of the genera of

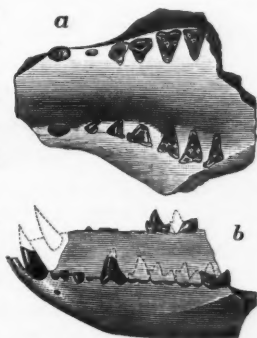


FIG. 19.—*Didelphodus absarokæ* Cope, muzzle and corresponding part of mandible of one individual, natural size. Original, from Vol. III, Report U. S. Geol. Surv. Terrs.

Centetidæ, and other recent families both of Creodonta and Insectivora (Fig. 23). Of the genera with large canines, Chriacus has already been mentioned as having a simple fourth premolar with only an internal cusp to distinguish it from the genera of Sect. I of the family. Its true lower molars have an anterior V of three connected cusps. This is also the character of the inferior molars and fourth premolar of *Deltatherium* (Fig. 20), which is also peculiar in having but  $\frac{3}{3}$  premolars, and a diastema. In the three genera which remain, the anterior or

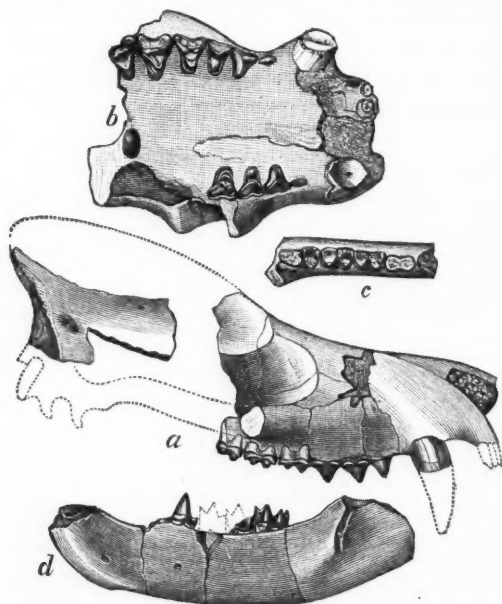


FIG. 20.—*Deltatherium fundaminis* Cope, skull and ramus mandibuli, two-thirds natural size, from the Puerco beds of New Mexico. Figs. *a b c* from one individual; Fig. *d* from a second animal. Fig. *a*, right side of cranium; *b*, palate, from below; *c*, mandible, part, from above; *d*, left ramus, outer side. From the Report U. S. Geol. Survey Terrs., Vol. III. Original.

fifth cusp of the true molars is rudimental. They differ from each other in the structure of the third superior premolar. In *Ictops* Leidy, this tooth has two external and one internal cusps; in *Mesodectes* Cope, there are one external and one internal cusps, and *Leptictis* Leidy, there is no internal cusp, and the external one is simple.

There are certainly three, and probably four, species of *Chri-*

acus. The typical and largest species, *C. pelvidens* Cope, is from the Puerco Eocene of New Mexico; the smallest species, *C. angulatus* Cope, is from the Wasatch beds of New Mexico and Wyoming (Fig. 14). Perhaps it is near this genus that *Tricentes* Cope, should be placed. The latter only differs from *Chriacus* in the possession of but three superior premolars.<sup>1</sup> I have suspected that it belongs near *Microsyops* and *Mixodectes* in the Lemuroid series. There are three species, none larger than a skunk. The type, *T. crassicollidens*, is known from parts of two crania. The *T. inæquidens* was not larger than a gray squirrel.

The *Deltatherium fundaminis* Cope (Fig. 20), is one-half larger than the Virginian opossum, and much more robust. Its molar teeth are very opossum-like, while its canine teeth are relatively larger and stouter. The crowns of the canines are especially effective as weapons, from their vertical direction and form, their sharp anterior and posterior cutting edges, and their sides grooved like many blood-letting instruments. The sagittal crest is high, and the muzzle is short and wide, so that a decidedly bull-dog expression belonged to this animal. It is the most specialized form of the family and of the Puerco epoch, and was one of the most abundant. There are two other less known species of *Deltatherium*.

(To be continued.)

—:O:—

## ANATOMY AND PHYSIOLOGY OF THE FAMILY NEPIDÆ.

BY WILLIAM A. LOCY.

(Continued from page 255.)

*The Salivary Glands.*—The most anterior appendages to the alimentary canal are the salivary glands. These are especially well developed in the Hemiptera, and secrete a juice which doubtless aids in the digestion of food. The *Nepidæ* have four glands in two pairs, each pair consisting of a small gland and a large one, which open by ducts near the commencement of the œsophagus. The large glands, which are about five times the length of the small ones, extend back to the first abdominal segment, and are there united to the stomach by threads of tracheæ. At the anterior ends of the large glands are two round pouches, which probably serve for the storage of small quantities of saliva.

<sup>1</sup> See Proceeds. American Philosoph. Society, 1883, p. 315.

Connected with the salivary system, but separate from the glands, are two sigmoid pouches, called salivary reservoirs, which are supposed to serve for storing larger quantities of saliva. These are applied to each side of the stomach, at its commencement, and are continued backwards by a tubular appendage, which ends blindly in the first abdominal segment, being there attached to the stomach and to the large salivary gland by tracheary threads. The ducts of the reservoirs are kept open by a transversely striated ribbon, coiled in a spiral manner, and thus are similar to the tracheæ in structure.

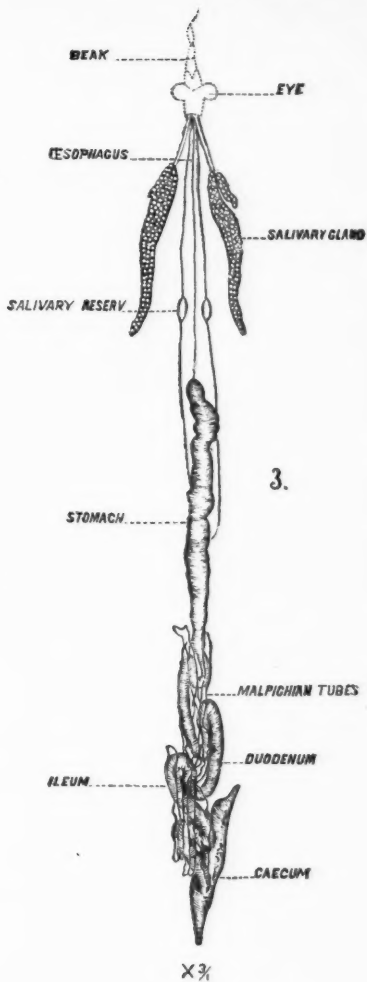
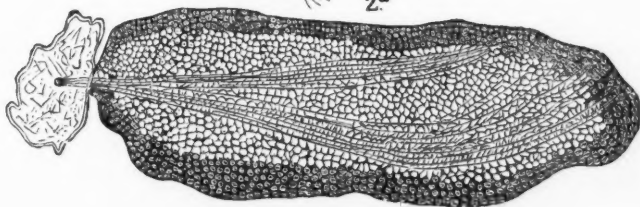
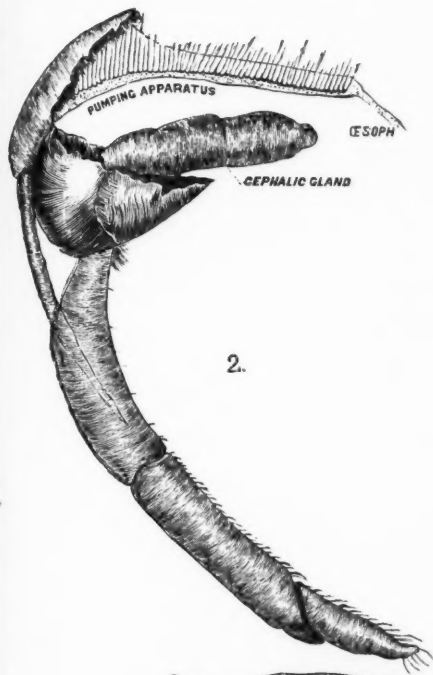
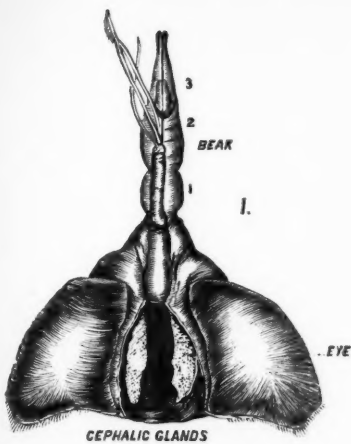
The salivary glands are conglomerated and, therefore, of high order. The globules are closely packed, sessile, and situated upon tubules, which join with others of like origin, and empty their contents into a common duct.

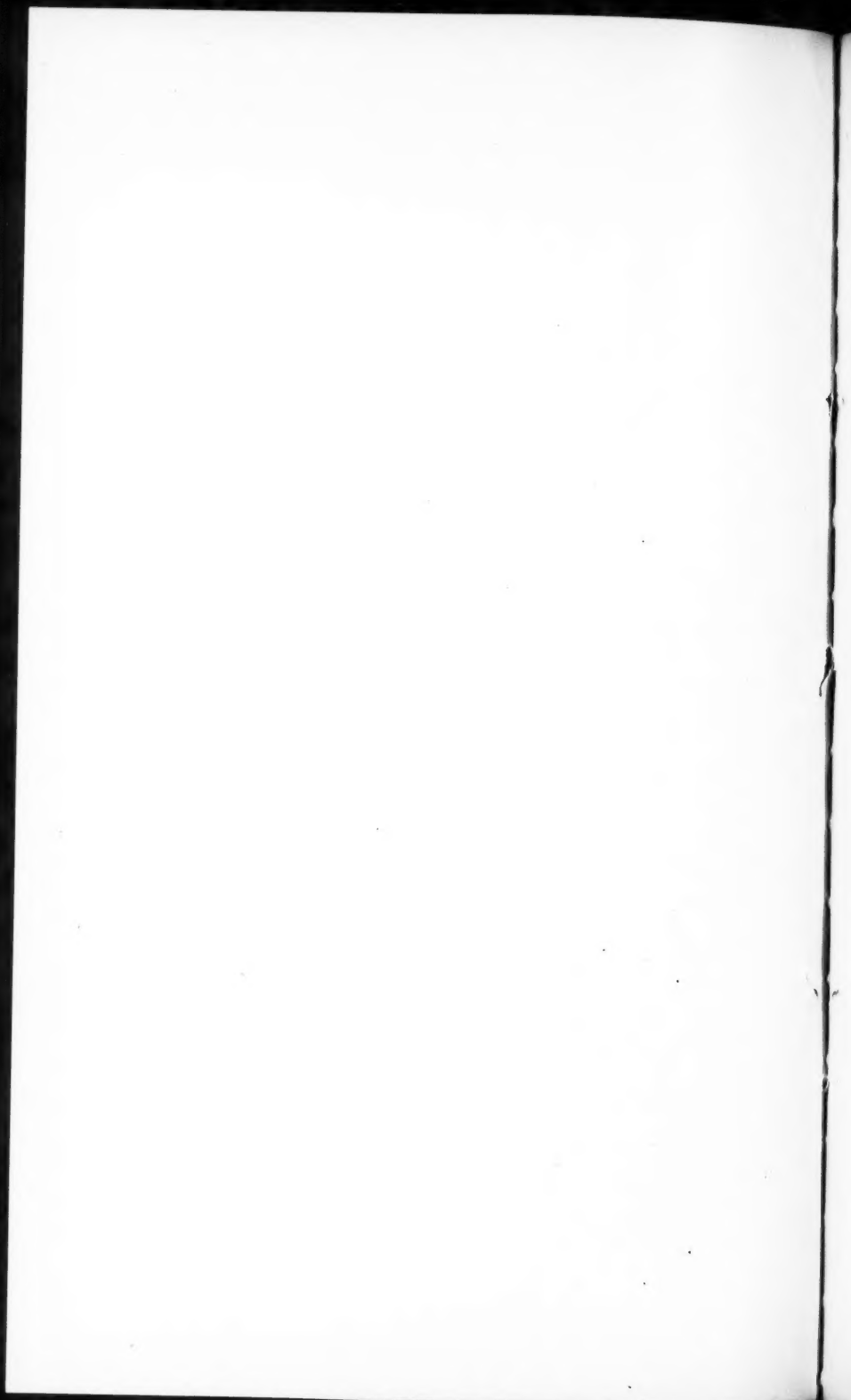
Comparatively speaking, the glands in *Ranatra* are not as long as those of *Belostoma*, and the salivary pouches, at the front end, are lacking. The salivary reservoirs are lenticular, and their cæcal appendages are longer than in *Belostoma*.

*The Malpighian Tubules.*—The Malpighian tubules, so named from their discoverer, Malpighi, are appended to the intestine. They consist of two tubules, of small and uniform size, united by four insertions to the bulbous enlargement of the intestine; each insertion is mediate, *i. e.*, connected with a pouch which opens into the intestinal bulb. These tubes are much convoluted and matted about the bulb, and are closely applied over the intestine, extending also over the stomach and into the fat body. On account of the difficulty with which they are unrolled, no exact measurements of their length has been made. I should judge, however, that they are about six or eight times the length of the body.

They have been indifferently called biliary or hepatic tubules, on account of their supposed function; but the discovery of uric acid and other urinary products in their secretions, indicates for them a urinary function. It is possible, that in some cases they unite with this urinary function the secretion of a sort of bile. The opinions of anatomists of the past half century regarding their function are various. By Cuvier, Dufour and Carus, their function was believed to be biliary, and by Strauss-Dürckheim and other anatomists urinary. These contrary opinions were, in a measure, reconciled by the views of Lacordaire, who believed their function

PLATE IX.





to differ according to position on the alimentary canal, of which, in the Insecta, there are three—on the stomach, biliary alone; on the post-ventriculus, urino-biliary; at the extremity of the alimentary canal, urinary alone. According to this view they would be urino-biliary in the Nepidæ. I am not prepared to speak concerning their function, as I have made no analysis of their secretions.

*The Fat Body.*—The internal organs are entirely enveloped in a fatty tissue, called the fat body, which divides the heart and the nervous system from the other organs of the body. It is composed of connective tissue holding in its meshes globules of fat. This fat body is always a serious encumbrance in tracing the respiratory system, and it also obscures other internal organs. The fat may be dissolved in sulphuric ether, after which the branching of the tracheæ may be studied. This tissue is most strongly developed in the abdomen, and in the Nepidæ I have noticed that it is thickest in the fall, and becomes thinner when the insect is deprived of food; it is probably, therefore, a storehouse of nourishment, and may also serve as a protection to the internal organs.

*The Odoriferous Glands.*—In *Belostoma*, the odoriferous glands are two cæcal pouches situated in the metathorax, under the commencement of the stomach. They are convoluted several times upon themselves, and the distal and anterior ends are close together, both concealed under the nervous cord; the external opening is between the coxæ of the posterior legs. When extended, they will reach to about the fifth abdominal segment. The smell emitted by these glands is pleasant, resembling that of well ripened pears or bananas.

*The Glands of the Head.*—In the genera, *Belostoma*, *Perthostoma* and *Ranatra*, I have observed two glands within the head, similar in position to the green glands of the Crustacea, which I shall provisionally name the *cephalic glands*, since they are not mentioned in any authority to which I have access. (Plate ix, figs. 1, 2 and 2a.) They are on the floor of the head cavity beneath all the other organs, and therefore are most easily approached from beneath. Their external openings are on each side of the head, between the eyes and the base of the beak. The ducts are short, and seem to be composed of a number of united ducts, which originate in individual cells. Under the microscope these glands show a thin homogeneous enveloping layer, and an

epithelial layer composed of five-sided cells, each containing a prominent central nucleus. In some cases two nuclei are present. When these insects are irritated, a secretion is freely thrown out around the base of the beak, which produces death very quickly when introduced on a needle point into the body of an insect. The "cephalic glands" may be the source of this poisonous secretion; on the other hand their function may be entirely different; this question may be decided by the chemical analysis of the secretion of these glands, that is now being made in the University of Michigan.

## II. THE CIRCULATORY SYSTEM.

After the food is reduced to chyle in the alimentary canal, it passes by osmosis through the walls of the intestines into the general circulation; it is conveyed in this way to various parts of the body, and converted into tissue. The circulation of the blood and the structure of the heart in insects is considered one of the most difficult points in their physiology, on account of the delicacy of the structure involved, and the confusion that has arisen among authorities from the absence of true arteries and veins. So much interest and importance is attached to this subject, that I give below a brief history of it.

About the middle of the seventeenth century Swammerdam and Malpighi, each independently, discovered in the larvæ of certain insects a rhythmically contracting vessel lying along the back, which they considered a heart. In the course of time Lyonet threw some doubt upon this conclusion in his memorable work on the larva of *Cossus ligniperda*. This doubt was increased by Cuvier, who, after a special study of circulation in insects, gave as his opinion that no such thing as a regular circulation existed in this class of animals. Thus naturalists came to believe that insects had no circulation.

In the early part of the present century, however, Carus made the true discovery of the circulation of blood in the Insecta, and his proof was too strong to admit of question. He saw, with the aid of his microscope, in a small transparent insect, blood leave the heart, circulate through the limbs, wings and antennæ, then return to its starting point, thus tracing the complete circulation. His results were published in the year 1827, and were soon confirmed by other naturalists.

In studying this subject in the Nepidæ, I have imprisoned

larvæ of *Belostoma*, *Perthostoma* and *Ranatra* in flat glass boxes, and, with the microscope, have studied the heart, and traced the circulation through the transparent integument.

The *heart* here described is from dissections of *Belostoma*. It consists of a long tube extending from the sixth abdominal segment to the supra-œsophageal ganglion. In the abdomen, it is divided into chambers, and this abdominal portion is considered the heart proper, and the anterior tubular portion, the aorta. There are five chambers in the abdomen of the adult, with afferent openings on each side, called by some auriculo-ventricular apertures. At the beginning of the sixth abdominal segment, the heart is attached to the integument by means of muscles. (Fig. 4.)

The first pair of afferent openings are thus thrown into the fifth abdominal segment, and the three following segments have one pair each, making a total of four pairs. These openings are guarded by valves, the action of which will be considered later. These apertures are all anterior to the middle of the body segment in which they are situated. In the larvæ of *Belostoma*, I have often observed one of these auriculo-ventricular openings in the sixth abdominal segment, and muscular attachments behind it in the anal prolongation. It is my belief that this additional chamber is dropped in the adult form, since I find it in none of my dissections. It is a matter of great difficulty to be sure, whether one of these chambers may not have escaped notice. According to my observations, however, there are five chambers in the adult *Belostoma* and six in the larva. At the junction of the thorax and the abdomen, the heart bends downward as it extends forward, passing under the large muscles of the thorax.

*The triangular Muscles of the Heart.*—The heart is attached to the integument in the abdomen, by a number of triangular muscles with their apices pointing outward. I have counted eight pairs of these attachments in the adult *Belostoma*. They are situated opposite each auriculo-ventricular orifice, and continue both anteriorly, and posteriorly, beyond these openings. At the apex the fibers composing the triangular muscles are closely united into a sort of ligament. These fibers diverge laterally as they approach the heart, and also divide into two sheets, one passing above and the other below the heart. Thus a triangular cavity is left on each side of the heart, which is called the *pericardial*

*sinus.* According to Milne-Edwards this has some claims to be considered the auricle of the heart, since its muscles help force the blood through the afferent openings into the heart. In addition to the triangular muscles, the heart is attached in the thorax by a single triangular piece of connective tissue.

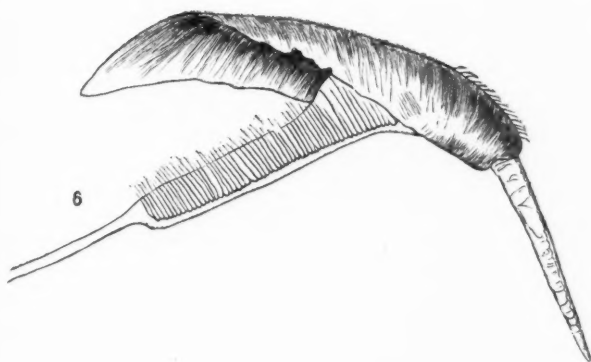
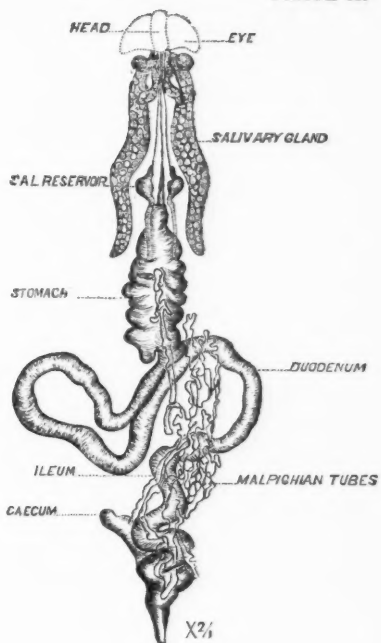
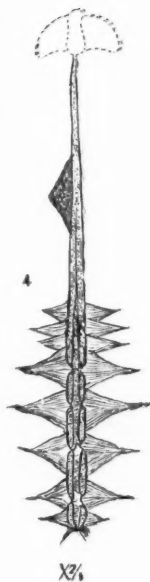
The heart beats rhythmically, its activity depending greatly upon whether the insect is quiet or excited. As near as I could conclude, the normal number of beats in *Belostoma larvæ* is about forty-five per minute. In those confined in glass boxes the number of beats were from thirty-four, to sixty-three, per minute.

The contraction of the different chambers is not quite synchronous; the back chamber contracts first, then the others follow in quick succession, so that the blood is kept constantly moving forwards. At the beginning of the diastole of the heart, the valves guarding the afferent openings bend inward with a quick, almost jerking motion, and permit the entrance of blood from the pericardial sinus; upon the systole of the heart the pericardial sinus receives an accession of blood from the chambers leading to it; the closing of the valves of the afferent openings prevents the return of blood from the heart to this cavity. It has been determined by the investigations of Dogiel, and others, that the heart is kept beating by ganglionic corpuscles, like the heart in vertebrates.

The course of the blood is forward in the heart to the nervous ganglia of the head, where the aorta ends in a funnel-like expansion. From here the blood is thrown into the lacunæ, which are regular channels leading through the connective tissue and among the organs of the body. Although there are no true arteries and veins, the course of the blood is regular through the lacunæ, and the heart may be easily injected by throwing fluid into the body cavity. I have often injected the heart of the *Nepidæ* by throwing carmine into the ventral cavity. The blood passes into the legs, wings, antennæ, etc., and comes back to join two large currents passing backward along each side of the body; ultimately it gets back to the pericardial sinus, from thence into the heart to begin its course anew.

*The Pulsatile Organs of the Legs.*—Accessory to the circulation is a special system of pulsatile organs, found in the three pairs of legs of these insects, generally situated in the tibia just below its articulation with the femur. In the raptorial legs of *Ranatra*, however, the organs are in the clasp joint, or tarsus, below its articulation with the tibia.

PLATE X.





Observations on their influence over the circulation, etc., will be found in the January number, 1884, of the *AMERICAN NATURALIST*, where my investigations and results are given, that lead to the three following conclusions on these organs: (1) They are separate from the muscular system of the legs; (2) they influence circulation; (3) they are automatic.

### III. THE RESPIRATORY SYSTEM.

Connected with the respiratory system of the *Nepidae* there is a breathing apparatus, which is peculiar to this family of insects. This characteristic consists of an anal *respiratory siphon* formed by the apposition of the grooved faces of the caudal setæ. Some aquatic larvæ have an analogous, though differently constructed breathing tube, which always disappears in the adult. The caudal setæ of *Belostoma* and *Perthostoma* are comparatively short, but in *Ranatra* are conspicuous for their length. In breathing, these insects rise to the surface and thrust their respiratory siphon out of the water. At the bottom of this tube are two anal stigmata opening into the two main lateral trunks of the respiratory system. In the adult insect, the anal stigmata are the only open ones in the whole abdomen. In addition to these *Nepa* and *Ranatra* have, on the ventral surface of each of the third, fourth and fifth abdominal segment, two prominent stigmata, which are closed by a sieve-like membrane and, according to Gerstaecker, perform the functions of tracheary gills.

In the adult *Belostoma*, the abdominal stigmata are so nearly obliterated that often their scars can be scarcely found with a lens; but the case is strikingly different in the larval forms, which have six prominent stigmata on the last five ventral segments. The last abdominal segment bears two pairs, and each of the four following, one pair each. I noticed in some cases, a spot on the membrane between the first abdominal segment and the mesothorax, which is, perhaps, an additional stigmata, though the work on this point is not very definite. The stigmata show a vestibule on cross section, and lie in a hairy track with their openings guarded by hairs.

The chief external differences between the abdomen of the larva and of the adult *Belostoma* may be summed up as follows:

*Larva.*—The ventral surface is covered with rather coarse hairs, the dorsal surface smooth, the stigmata prominent and all open,

the sixth abdominal segment comparatively small, and the caudal setæ undeveloped.

*Adult.*—The ventral surface is smooth, the dorsal surface pubescent, the stigmata totally obliterated, and the caudal setæ developed.

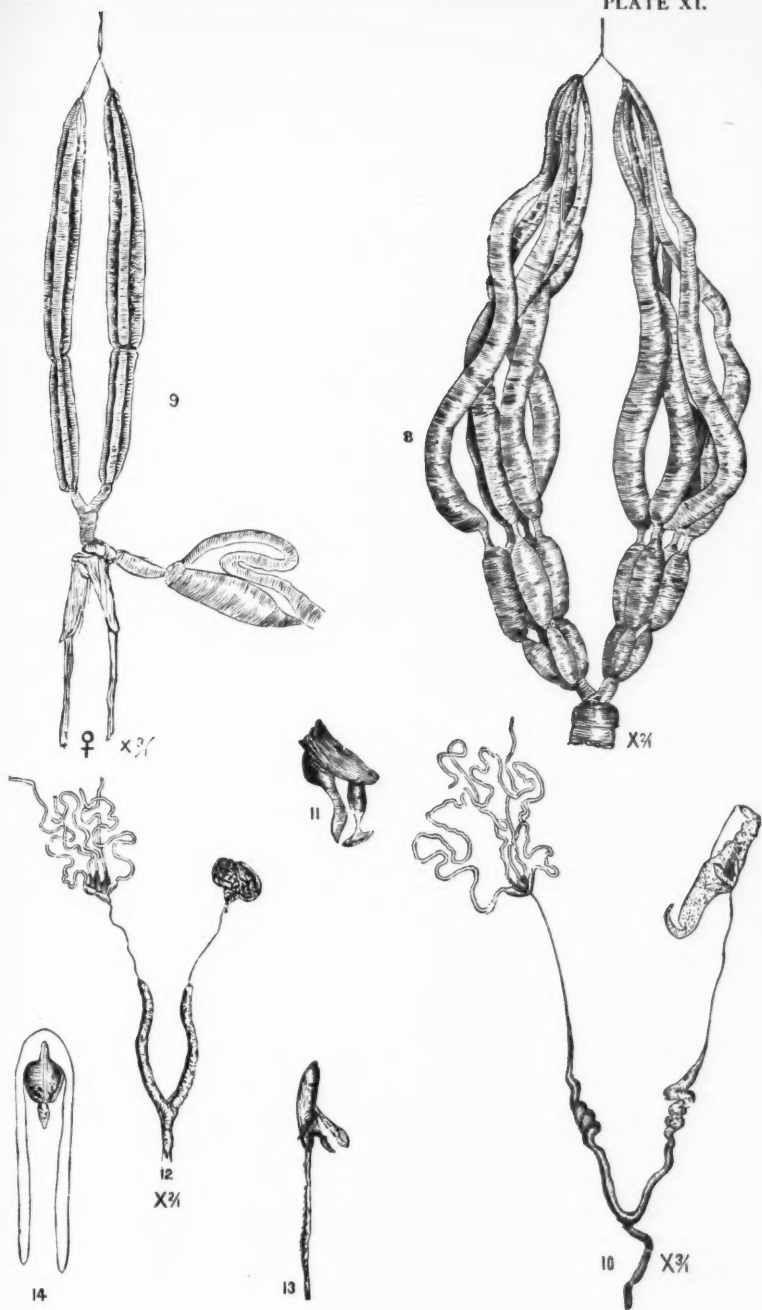
The tracheary branches are distributed to all the organs of the body, so that the chemical processes of respiration are effected throughout the body instead of at special points. From the anal stigmata, two main trunks extend along the abdomen on each side of the heart, giving off and receiving branches which anastomose among themselves. The large trunks are connected by an arcade of tubes running below the intestines. In the larva, branches from the spiracles join the main trunks, and in the adult, after the obliteration of the spiracles, these branches are still found attached to the integument. The distribution of tracheæ to the muscles and organs of the forward part of the body, is very plentiful; large branches extend into the legs and wings; in the mesothorax the nervous ganglion rests on a triangle of tracheæ. Here, too, connected with the trachea, are several air sacs, which are inflated before flight. The dorsal and ventral walls of the abdomen are connected by two vertical rows of muscles, which are doubtless concerned in respiration.

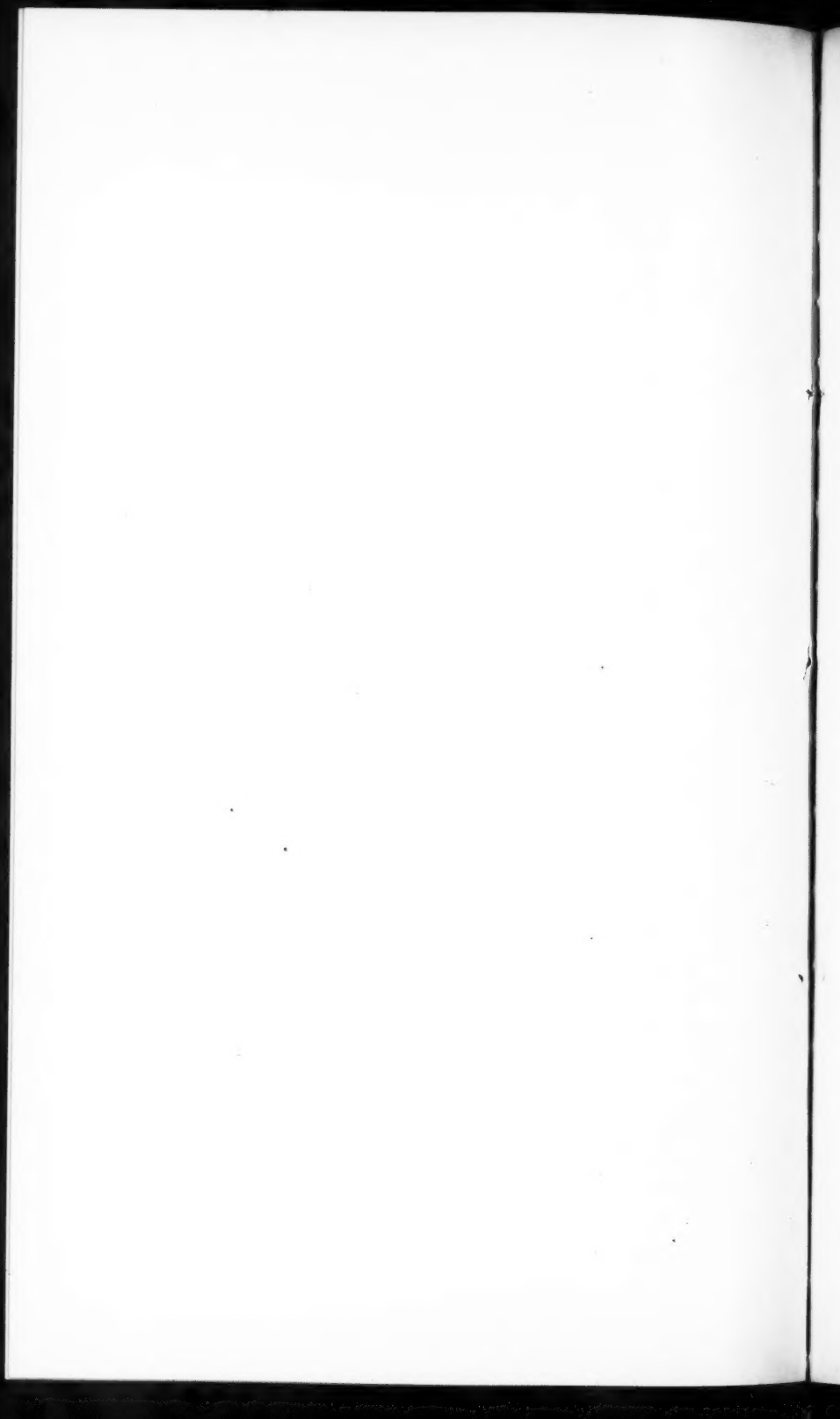
Three kinds of tracheæ are found in these insects: tubular, vesicular and parenchymatous. All the main trunks and branches of the respiratory system are composed of tubular trachea; this, as shown by Minot, consists of an external nucleated epithelium with two internal layers, in one of which is found the spiral thread that keeps the tube open. This spiral filament is not continuous, but separate in each branch, and consists of numerous parallel pieces, each of which tapers to a point after a few turns and thus is lost. The vesicular trachea of the air sacs chiefly differs from the tubular trachea, in lacking the spiral thread. I have made no study of the parenchymatous trachea noted by Dufour as occurring in *Nepa*. It consists, according to this author, of several pouches covered by a fine, satin-like envelope, within which, minute tracheary branches are matted. These pouches are situated in the thorax under the Scutellum.

#### B. THE FUNCTION OF REPRODUCTION.

The function of reproduction, which includes generation and development, is here confined to generation. As in the Verte-

PLATE XI.





brata so in the Insecta, two kinds of organs are concerned in this process, the mutual action of whose products upon each other, is usually necessary for the formation of new individuals. These organs are the male organs or testes, producing spermatozoa, and the female organs or ovaries, producing eggs.

#### I. THE MALE GENERATIVE SYSTEM.

The testes of the male *Belostoma* lie in the anterior portion of the abdominal cavity, on each side of the pyloric end of the stomach. They consist of a rounded body, which in reality is a membranous sac, mounted on a sort of receptacle composed of five pieces closely packed together. From each of these five pieces, arise spermiferous tubes which are much matted in the membranous sac. (Fig. 12.) The vas deferens, which leads backward from the testes, is thread-like for the first half of its course, and then enlarges into a tube, which joins with the one from the opposite side to form the ductus ejaculatorius, which conducts the spermatic fluid to the organ of intromission. (Fig. 11.) This is formed by two pieces, a pick-shaped structure above and a spoon-shaped one below it; both organs are situated on the genito-anal prolongation, which corresponds to a dorsal and ventral part of a seventh abdominal segment. The prolongation is provided with copulatory hooks, which in the female are rudimentary.

In *Ranatra*, the general arrangement of the generative apparatus is the same, though in detail, somewhat different. The spermiferous tubules are confined in an elongated sac, which is much farther forward than in *Belostoma*, and the vas deferens, after enlarging, is coiled several times upon itself before passing into the ductus ejaculatorius (Fig. 10.) The coils are compact and form a lenticular enlargement on the vas deferens, sometimes mistaken for the testes.

#### II. THE FEMALE GENERATIVE SYSTEM.

The ovaries of the female consists of two series of five tubes each, one on either side of the body. These terminate in the thorax, where their small pointed ends are joined together by connecting threads, which serve also to attach them in the thorax. Proceeding outward they gradually grow larger until they all meet at the calices, the tubes of which unite to form the vagina or oviduct. These organs vary greatly in size according to the season, sometimes quite contracted, and sometimes so distended with

eggs as to fill nearly the whole abdominal cavity. The tubes of the ovaries double upon themselves in the first segment of the abdomen, the flexure reaching back nearly to the third segment. (Fig. 14 *a*.)

As already noted, the females of *Perthostoma* carry their eggs upon their backs until hatched, the young then escaping by means of a trap door at the top of the egg. The number of eggs borne by any insect is variable; I counted them in four individuals with the following results: 207, 185, 184, 183, and other females were dredged bearing less than half as many. The eggs of *Ranatra* and *Nepa* are crowned with setæ, two on the eggs of *Ranatra* and six on those of *Nepa*, while the eggs of *Belostoma* and *Perthostoma* have none.

The female generative organs of *Ranatra* lack the flexure that occurs in those of *Belostoma*, but in other respects are quite similar. Their chief differences may be seen on reference to Figs. 8 and 9, Plate XI, which are drawn on the same scale.

#### C. THE FUNCTION OF RELATION.

To secure a just harmony in the activity of the different organs of the body, a combining organ of some kind is necessary. The food must be adequate to meet the waste of the body. Intelligence to know when food is needed, and to discriminate between nutritious and innutritious food is essential; respiration must be regulated to supply enough oxygen, but not too much. These and all other processes of animal life must be brought into relation with each other, otherwise the organs would be useless. This round of duties, which is performed by the nervous system and the muscles, over which it has control, constitutes the function of relation. In some respects it is the most important function, since it directs all the others.

#### I. THE NERVOUS SYSTEM.

The insects of this family are keen and shrewd in detecting their prey, and energetic in procuring it, hence their general nervous condition must be an active one. They show a considerable degree of cephalization, all the abdominal ganglia have advanced to the mesothorax, where they unite with others to form a complex thoracic ganglion. The remaining ganglia form two conglomerate masses, one below the œsophagus, called the infra-œsophageal ganglion, and the other above, called the supra-œso-

phageal ganglion, sometimes considered the brain. This brain consists of two "cerebral lobes" slightly overlapping, and sending two large commissures around the œsophagus to the infra-œsophageal ganglion. The optic lobes, which are somewhat pear-shaped, extend obliquely from the summit of the "cerebral lobes" toward the eyes, and give rise to the numerous fibers of the optic nerves.

The cerebral ganglia send nerves to the antennæ, and also send a small branch to the frontal ganglion. This ganglion is a small knot of nervous matter situated on the median line of the head, just in front of the cerebral ganglia. The frontal ganglion supplies the œsophagus anteriorly, with nerve filaments and posteriorly, by filaments from a main branch extending backward underneath the "cerebral lobes." "The respiratory ganglia," which I did not find, are described by Dr. Leidy as "two small ganglia behind the brain, on each side of the œsophagus and connected with each other and with the 'cerebrum' by exceedingly delicate commissural filaments." From each side of the infra-œsophageal ganglion a bunch of nerves originates, which sends branches to the muscles and the organs of the prothorax, and to the anterior legs.

A double commissure connects the infra-œsophageal ganglion with the complex ganglion of the mesothorax. The latter gives off branches anteriorly, laterally and posteriorly. The anterior branches partly supply the prothorax; the lateral branches supply mainly the organs and muscles of the meso- and metathorax and the posterior legs; and the posterior branches, the muscles and organs of the abdomen (Fig. 17).

## II. ORGANS OF SPECIAL SENSE.

Although there is good evidence of the existence of the special senses among insects, considerable speculation exists concerning the location of all, except the sense of sight.

*Touch.*—In these insects the sense of touch through the integument must be very blunt, and the real organs of this sense probably are the tactile hairs found on different parts of the body. These hairs communicate with the terminations of the nerve fibers beneath the integument. I have often been impressed with the idea, that the tufts of hair found at the extremity of the beak, in all the Nepidæ, are especial organs to give it a delicate sense of touch.

*Taste and Smell.*—The work on these insects as far as carried out, furnishes no suggestion as to the location of the senses of taste and smell, and, as far as my knowledge goes, their existence rests wholly on analogy. In some insects, as the Silphidæ, smell is obviously present and directs them to their food; and taste is probable in insects possessing soft tongues.

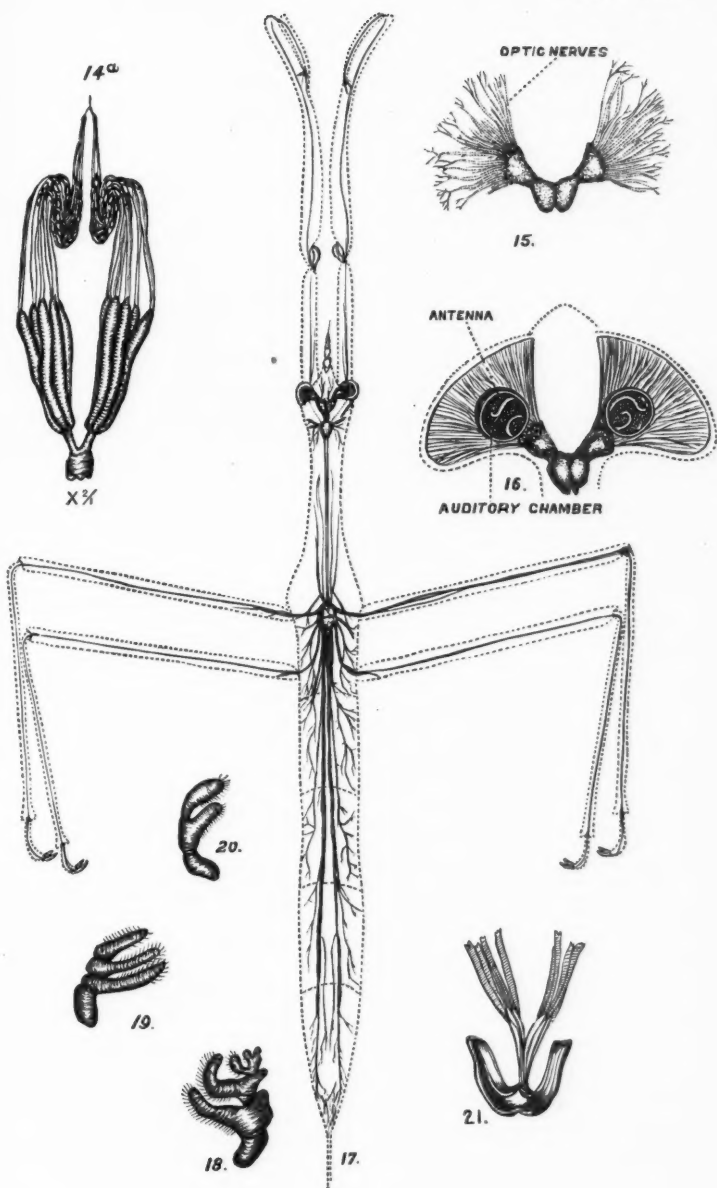
*Hearing.*—Hearing in the Insecta is usually located by anatomists in the antennæ. This is made very probable by investigations similar to those of Mayer, the physicist, on the mosquito. This observer, by watching through the microscope the hairs on a mosquito's antenna, found that they responded by vibrations to certain sounds that he produced; the hairs, being of different lengths, responded to several sets of vibrations, but always strongest to the note emitted by the female mosquito.

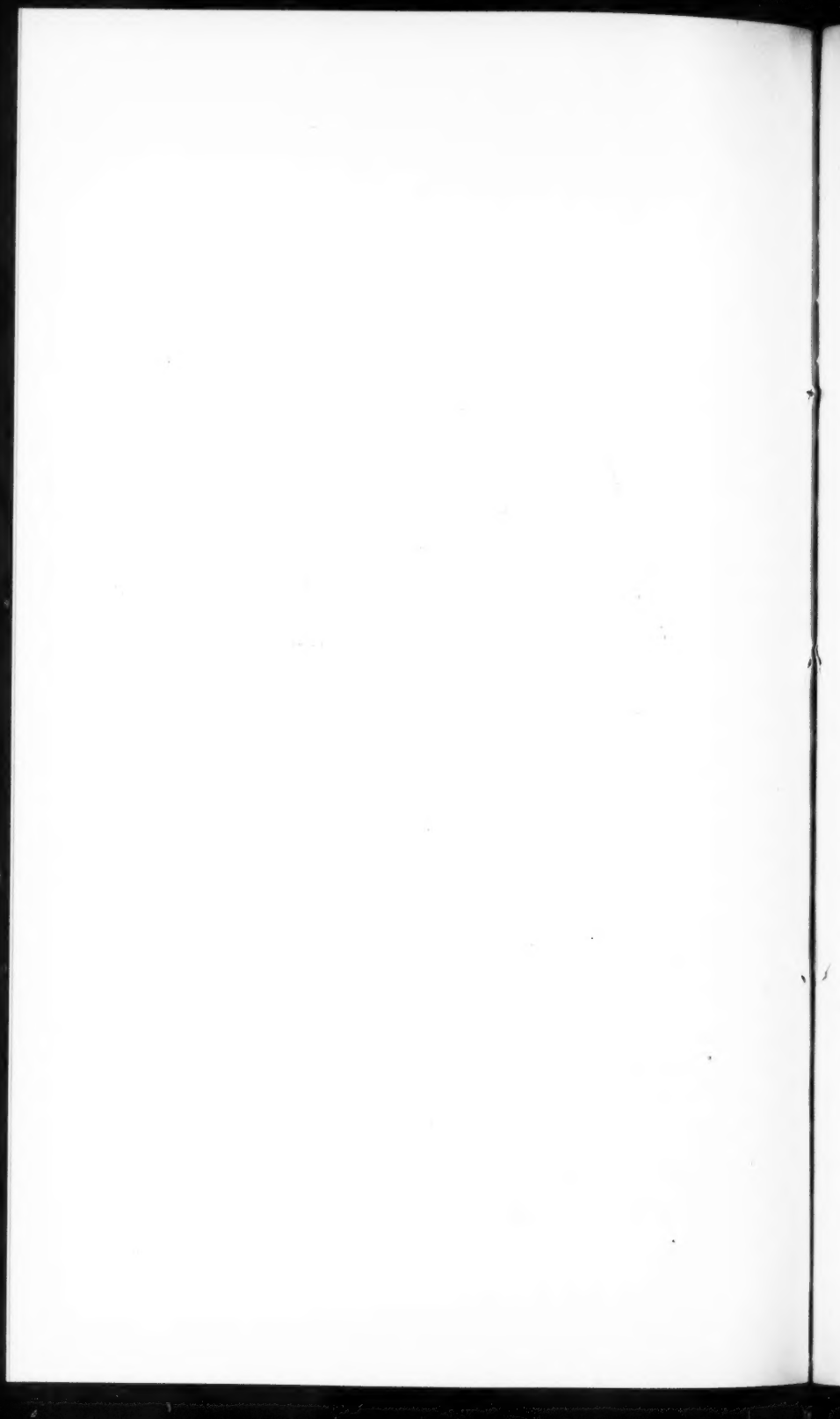
Other experiments of a similar nature, and the fact that some insects appear deaf when the antennæ are removed, add force to the conclusion that they serve as organs of hearing. A few insects, the Orthoptera, for instance, have special organs for the reception of sound, either on the thorax or at the base of the anterior legs.

In the Nepidæ, there are certain conditions in the situation of the antennæ that seem to me favorable for the increase of sound vibrations. The *Belostoma* and *Perthostoma* have each of the antennæ enclosed in a vaulted cavity, which is suggestive of a resonance chamber. Each chamber extends into the eye above it, and separates the fibers of the optic nerve into two bundles; and its opening below the eye is partly closed, so that a cleft is left toward the median line of the head, through which the antennæ may be protruded or withdrawn. The antennæ are well provided with sensitive hairs (Fig. 18), which doubtless respond to the sound vibrations received in the auditory chamber. In cross-section the auditory chamber presents a view shown in Fig. 16, Plate XII. The *Ranatra* emits a squeaking sound by working the front legs up and down on the joint at the coxæ, where the roughened surfaces come together.

*Sight.*—The Nepidæ have two prominent compound eyes, one on each side of the head, but no ocelli. They are covered externally by a modification of the integument, which answers to the cornea of the vertebrate eye. This is divided into a great number of hexagonal facets, underneath each of which is found a crystalline

PLATE XII.





cone with the apex directed backward. The filaments of the optic nerve are branched at their extremities (Fig. 15); each of these branches probably enters a cone. The theory of mosaic vision is so generally discussed that no repetition of it is needed here.

### III. THE MUSCULAR SYSTEM.

To bring an animal into true harmony with its surroundings, muscles are necessary to move the body from place to place, so that the animal may court agreeable, or favorable conditions, and shun disagreeable, or unfavorable conditions.

No special study of the muscular system of the Nepidæ has been made, but a few points that incidentally appeared during dissection are mentioned.

The most striking mass of muscular tissue is in the meta- and mesothorax, the muscles of which are mainly concerned in flight and in moving the limbs. The muscles of the legs are well developed, and may be studied through the integument if it is scraped thin. The elevators and depressors of the beak, and the muscles of the beak bristles, are easily demonstrated in the head and in the prothorax. The respiratory muscles of the abdomen, and the muscles of the pharynx, have already been described. In many cases special provisions for the attachment of muscles are provided by means of chitinous processes and chitinous threads. The latter are very conspicuous in the prothorax of *Ranatra* and in the retractor muscles of the setæ. The chitinous processes are found plentifully in the meso- and metathorax, and two prominent ones are borne on the back of the head.

*Conclusion.*—Even in this cursory view of the family Nepidæ, the adaptation of organism to function is often too obvious to escape notice. The influence of food and surroundings, the two most important factors in modifying structure, is seen producing great similarity of internal organs, under variable external form. The adaptive characters are also very apparent in the raptorial fore-legs, the beak, the sucking pharynx, the respiratory siphon and in many other structures. The general principles of their physiology is the same as that of the vertebrates. There is the same conflict between waste and repair, the identical processes of changing food into muscle and nerve, the same general chemistry of respiration, etc., etc. They are not endowed with mind, but possess sufficient nervous sense to meet their requirements, and,

although built on a simpler plan, are as distinctly physiological machines as are all vertebrates.

#### DESCRIPTION OF PLATES IX, X, XI, XII.

- FIG. 1.—Head of *Belostoma* larva seen from above, dissected so as to show the cephalic glands. In front is seen the beak with the sheath and bristles withdrawn, and the bristles pushed to the left.
- FIG. 2.—Side view of beak and portion of head of *Perthostoma*, with pumping apparatus and one cephalic gland attached. In this case the sheath extends into the beak, as is natural. The bristles are not shown.
- FIG. 2 *a*.—View from above of the cephalic gland of adult *Belostoma*,  $\times$  about 20 diameters.
- FIG. 3.—Digestive apparatus of *Ranatra* ( $\times \frac{1}{2}$ ). The Malpighian tubes are represented in part only, portions having been removed in dissecting.
- FIG. 4.—Heart of adult *Belostoma* ( $\times 2$ ), showing triangular muscles, the different chambers of the heart and the afferent openings. Some of the muscular fibers should be represented as crossing above the heart. Anterior to the muscles on the left is seen the triangular attachment of connective tissue.
- FIG. 5.—Digestive apparatus of *Belostoma* ( $\times 2$ ). The salivary glands and the ilium are represented as *too wide*. Part of the Malpighian tubes were removed before the drawing was made.
- FIG. 6.—Portion of the head of *Belostoma* with the sheath and the pumping apparatus attached (magnified at least twenty diameters). The œsophagus enters the pumping apparatus from the left. The oblique lines represent the chitinous threads for muscular attachments.
- FIG. 7.—Cross-section of the pumping apparatus (magnified as above).
- FIG. 8.—Female generative apparatus, extended and spread, from a large specimen of *Belostoma* ( $\times 2$ ). Compare with Fig. 14 *a*.
- FIG. 9.—Female generative apparatus of *Ranatra* ( $\times 3$ ). Three tubes of each ovary in sight. Below is seen the cœcum and a part of the intestine pushed to the right.
- FIG. 10.—Male generative apparatus of *Ranatra* ( $\times 3$ ). On the right is seen the elongated sac in which the spermiferous tubes are matted; on the left the sac is removed and the tubes spread out. The vas deferens, at first thread-like, enlarges and coils upon itself several times before emptying into the ductus ejaculatorius.
- FIG. 11.—Male organ of intromission, *Belostoma*, considerably enlarged. Drawn with the camera lucida.
- FIG. 12.—Male generative apparatus of *Belostoma* ( $\times 2$ ). Membranous sac rounded, thin, showing tubes within; on the left the sac is removed and the tubes spread as in Fig. 10. Vas deferens not coiled.
- FIG. 13.—Side view of genito-anal prolongation, one seta removed, and the penis elevated to the right. On the side of the genital prolongation is seen the copulatory hook.
- FIG. 14.—Genito-anal prolongation and caudal setæ, front view.

- FIG. 14 *a*.—Female generative apparatus of *Belostoma* ( $\times \frac{1}{2}$ ), showing the flexure of the ovaries and immature ova in their upper part.
- FIG. 15.—Portion of brain and optic nerves of *Belostoma*, to show the branching at the extremities of the optic nerves.
- FIG. 16.—Cross-section of head of *Belostoma* from above, to show the auditory chambers and parts of the enclosed antennæ.
- FIG. 17. Nervous system of *Ranatra* ( $\times \frac{1}{2}$ ). The branching of the nerves in the abdomen partly diagrammatic.
- FIG. 18.—Antennæ of *Belostoma*.
- FIG. 19.—Antennæ of *Perthostoma*.
- FIG. 20.—Antennæ of *Ranatra*. The last three figures from camera lucida sketches.
- FIG. 21.—Cross-section of pumping apparatus, showing how the muscles are attached to the chitinous threads, and how they divide into two sheets as they pass upwards.

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## TOPOGRAPHICAL PHENOMENA IN INDIANA.

BY JOHN T. CAMPBELL.

ABOUT fifteen years ago I was engaged in helping to make several surveys in Western Indiana and Eastern Illinois for railroad purposes. In such work one is apt to notice topography sharply. While thus employed I observed that the hills along all the east-west flowing streams on the up or table-lands were steep and abrupt facing northward, and on the opposite side, facing southward, they were gentle slopes. This was true throughout the glacial drift region. As the streams in nearing the Wabash river wore down below the drift, the slopes reversed, and the steepest hills faced the south, but the difference in slope is not nearly so noticeable as the opposite in the drift.

At the time I first observed this peculiarity of slope, I had read no work on geology, and had but a very limited idea of dynamical geology, derived from a meager recollection of a few lectures on the subject, heard several years before. I supposed these phenomena were not only observed and described, but accounted for. In my subsequent reading on the subjects which ought to cover this, I have been not a little surprised to find that these *facts* have not only *not* been accounted for, but not *observed*. After my failure to find it where I expected, I inquired of men eminent for their knowledge of such subjects as should include this, and have found that not one out of nine seemed to have observed or heard of the phenomena, and several even expressed a doubt of the existence of the facts.

During my subsequent readings and inquiries, I have greatly

extended my observations and investigations of the subject, and confidently believe that I am offering something new in what follows for the consideration of the scientist and philosopher.

In the month of May, 1881, I was employed on a railroad survey from Indianapolis, Indiana, to a point on the Ohio river. Nearly all this time was spent in preliminary lines in Brown county, about fifty miles south of Indianapolis, to find a practicable line across the several high ridges running east and west across this county. These ridges, according to Dr. John Collett, State geologist, headed off the glacial drift from this place. Certain it is there is no glacial drift south of the first or most northern ridge, though both east and west of these ridges the drift extends nearly to the Ohio river, and beyond it on the east side of the State. These hills or ridges look like small mountains, but they are only hills, there being no upheavals. The strata can be traced through all the ridges. These hills are composed almost entirely of Waverly sandstone, or knob-stone, as Indiana geologists call it. Valleys have been eroded over 400 feet deep, by small west flowing streams. The stone dissolves easily on exposure to the weather, hence the great amount of erosion by the small streams, much greater than the same water-shed shows in any other part of the State.

In this region the steep hills face the south, though the difference between opposite slopes is not half so great as in the drift regions to the north.

In the glacial drift region, especially on the high or table-land, where the stream valleys are shallow, the east-west flowing streams lay up close against the foot of the hills on the south side, and these hills are often as steep as a precipice, while on the north side (facing southward) they are often not over twenty degrees from a horizontal.

In this region the trees growing on the south-facing hillsides lean down hill much more than do those on the much steeper north-facing hills, or on the steeper east and west facing hills.

In Brown county, before mentioned, I could not discover any difference in the lean of the trees on the hillsides. The soil on these east-west ridges is composed of the decomposed sandstone before mentioned, and is very thin, especially on the hillsides. In this region the streams wash against the north hills (facing southward) noticeably more than the south side (facing northward), the

reverse of what is so plainly seen in the glacial drift region a few miles to the north.

Another fact of much importance, and quite as striking as the slope of the hills, is that in the large creek and the river bottoms the trees lean down stream, regardless of direction; that is to say, they lean in the direction of the flow of the water which deposited the ground on which they stand. In every case I have examined (I think several hundred), wherever the trees lean up the general course of the stream, there is found the trace of an ancient bend of the channel, turning back up itself for a short distance and abandoned on account of a subsequent cut-off. This tendency of the trees to lean down stream (where the flood deposit is six feet or more) is the same in the drift region and south of it where I have observed, and I presume it is in obedience to a law that is general over the world. At the upper end of the bottoms, where the deposit is old, the leaning tendency decreases, and is greatest at the lower end in the most recent deposits.

In this age it is not easy or comfortable to merely accept these facts and ask no questions. This problem-solving age *will* ask, What law is at work that makes all the north-facing hills from, Indianapolis west to the State line steep, and the south-facing gentle, while in Brown and the east part of Monroe counties, the steep hills face southward and the more gentle northward? The same clouds have rained on both localities; the same cold winds have frozen, and the same sun and warm winds have thawed both localities. The weather effects on topography would not change in the short space of ten miles; but we find a change as soon as we pass south of the southern terminus of the drift.

I offer an explanation of these phenomena for consideration and criticism, but wish to say here, that being aware of my limited knowledge on such subjects, I have submitted my facts and views to as many eminent geologists as I could reach, and sought their opinions. All have signified that this feature of the subject is new. Several have strongly denied my deductions; others have doubted the facts, while still others have given an agnostic shake of their heads—"We don't know." None have offered a better explanation, and my diligent search has found nothing to contradict my theory. As I have no scientific reputation to lose, I can afford to be the little elephant that tries the depth and swiftness of the waters.

The explanation I would suggest is, that sedimentary deposits from running water have always a tendency to move or slide in the direction of the flow of the water making the deposit, and this sliding tendency is in proportion to the swiftness of the water.

I assume that if a trench should be cut across the flood plain of a river at right angles to the current that made the deposit, and as deep as the bed of the river, the up-stream side would in no long time assume a slope of low inclination, while the down-stream side would remain steep, and drop down in falls whenever any change should take place.

Big Raccoon creek, a stream 200 feet wide, enters the Wabash river from the east in this (Parke) county, and flows westward across the Wabash bottoms for one and a half miles. The banks are twelve to twenty feet high, and those on the up-stream side (of the Wabash current) are easy slopes which a foot-man can easily descend to the water's edge, while all the way across this bottom, the opposite down-stream, or south side (facing northward), is like a continuous precipice. The trees growing along the north bank stand from the top of the bank well down to the water's edge, lean down hill from ten to forty degrees, while on the south side they stand erect till so far undermined that they fall into the stream. The current persistently beats against the left or south bank all the way across the Wabash bottom, the same as in the upland drift.

In this country the roads are mostly laid on the section lines, causing nearly all of them to run due north, south, east and west. This takes them over ridges and down and up steep hills, requiring deep cuts and heavy fills. These cuts, where they are through the glacial drift deposit, show the same condition as the creek banks before mentioned, the south-facing side of the cut has the gentlest slope. The water flowing down the gutters at each side of the roadway bear most against the south bank (facing north). The north bank (facing southward) shows much the greatest apparent plasticity, or mobility, to quietly slide down like soft putty and reform the gentle slope, while the opposite side drops down in falls like soft sandstone would be expected to do. I have noticed that the little blocks or cubes into which the drift clay separates in time of drought, have a dip southward in the line of their "season cracks," as we may call it. During protracted

rains the water percolates through these cracks, rendering the cubes soft and slimy, and aiding the plastic slide in the direction of the dip of the cube cracks—southward.

In support of the theory I advance—well, call it speculation—I submit the following facts: If a lump of putty, say twenty-five pounds, with a consistency that would maintain its shape, should have a number of small sticks or common matches stuck into it in an erect position, as shown by the dotted line in Fig. 1, these would represent trees growing on a hillside. If one side of this putty should be exposed to the heat of the sun or a fire, its consistency would be reduced and it would slide as shown by the solid line in Fig. 1, and the matches (trees) would lean down hill.

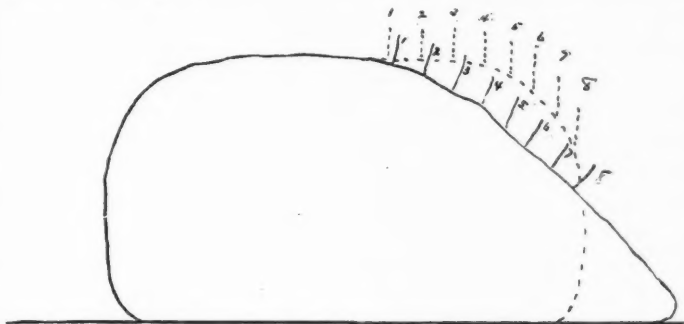


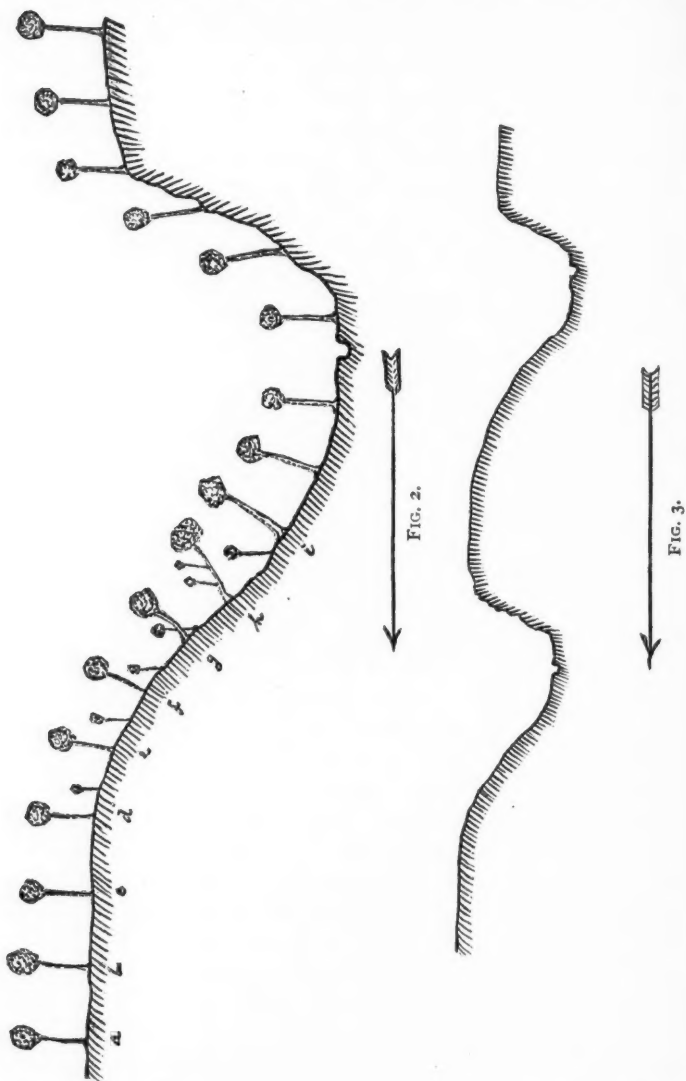
FIG. 1.

The trees always grow vertical unless inclined by some exterior force. On hillsides we find the young trees growing vertically, inclining down hill with age, the oldest inclining most. Without doubt the old trees started in life with good intentions, and tried to grow with the plumb line. When a tree is suddenly inclined as much as forty-five degrees, it will send out saplings from the upper side of its trunk. See tree *h* in Fig. 2, which figure illustrates the different slope of north and south-facing hills in the glacial drift, and the lean of the trees thereon.

Fig. 3 shows the profile of a railroad survey north and south, and crossing east or west streams and ravines in the drift region.

Fig. 4 shows the lean the trees would take at the bends in a river bottom as indicated by the arrows, and the slope of the hills on the north and south side of east and west flowing streams and ravines in the drift region.

As proof that the slope of the hills is not due to the surface



washing, or action of frost, we find the roots of the oldest trees about equally exposed at the top, side and foot of the hills;

whereas, if it was a surface movement, the roots would become bare at the hill top, and covered at the hill's foot, as shown in Fig. 5.

Where this is the case, as it sometimes is, the dotted line represents the surface when the trees began life, and the solid line the surface after rain washings.

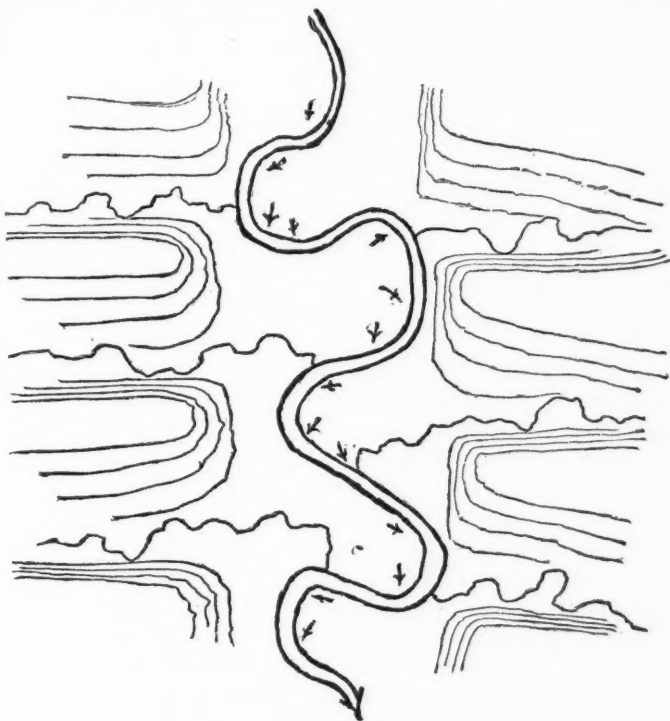


FIG. 4.

The first explanation of the less inclined south-facing hill in the drift is apt to be the lateral push of freezing. That the sun thawing out the south-facing hill so much oftener than the opposite, to be refrozen, gives it the greatest motion. A little reflection will explode this answer. The greatest number of thaws in real winter are due to warm winds and warm rains, when there will be no sunshine. These will affect both hills alike; beside the major part of every thaw comes from beneath and would affect both hills alike. I have seen too much power attributed to the

lateral push of freezing. A careful analysis of its process will show that it can have but little lateral push on level, or even much

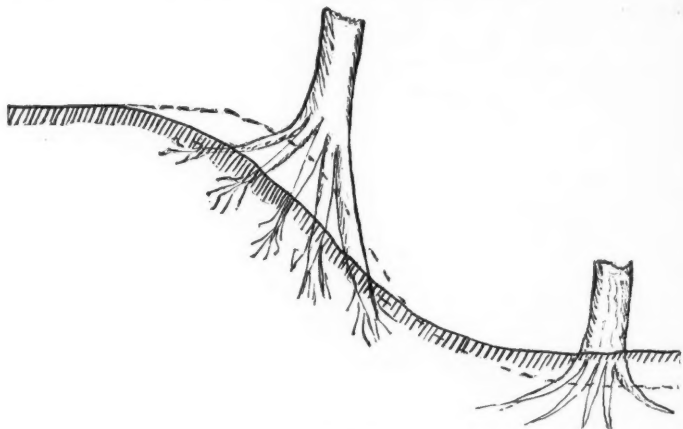


FIG. 5.

on inclined ground. The first freeze is a thin crust on top, not thicker than paper (and about as powerless as paper), which thickens downward as the freeze goes on. The next thickness of freeze below adds nothing to the lateral force of the first, nor does the next, and the next. The only force freezing exerts on the ground is an uplift. There are no cracks in frozen ground as we find in thick ice, which clearly shows that the very doubtful fact of *much* lateral expansion in the under freeze of ice does not apply at all to frozen ground. Cellar and other walls are often pushed in by freezing for the plainest reason. The freeze begins on the face of the wall, extends back through it to the ground, so that the uplift, *a b* in Fig. 6, becomes a side push, *b c*.

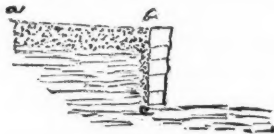


FIG. 6.

This inpush from a freeze never occurs where a cellar is kept warm, but the retain or guard wall of an outside stairway, and other outdoor walls, are often thus pushed. I am fully satisfied that the different slopes of the north and south facing hills is not

due to surface washing or the unequal lateral pressure of freezing.

I have made frequent inquiry of railroad section men, who all

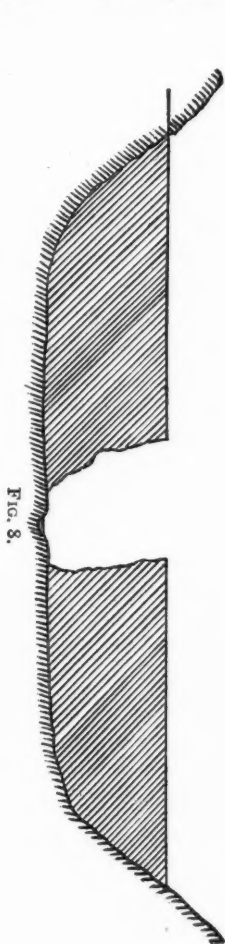


FIG. 8.

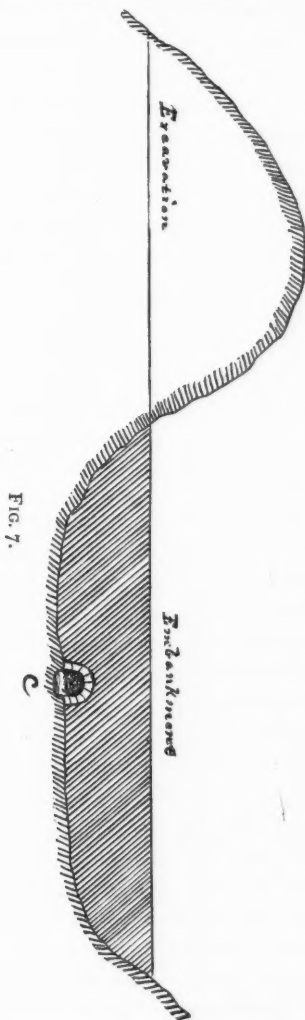


FIG. 7.

tell me that the north side of an east-west railroad embankment washes during rains and slides more than the south side; but the east-west cuts show the same phenomenon as the hills. As they

are constantly repaired the passer-by cannot see the natural effect, but section men say that the ditch on the north side of the cut fills much oftener than the other. Why does a railroad embankment slide one way, while the cut out of which it was taken slides the other? Because they were built by different processes.

Farmers in this country know that when they thresh their grain and stack the straw by carrying it forward from the thresher and throwing it over the forward or outer end of the stack, it will continue for months to slide in that direction, though it would be hard to detect the oblique stratification in the build of the stack.

If a railroad embankment should be built across a valley, with excavations from the adjacent hill carried and poured over the forward end of the embankment till completed, it would be in fact as it appears in Fig. 7, except that the eye could not detect the oblique stratification unless it was due to a change in the color or quality of the earth.

If, after this bank had become well settled, a "washout" should occur, carrying away the culvert, *c* Fig. 7, it would leave two walls standing, as shown in Fig. 8.

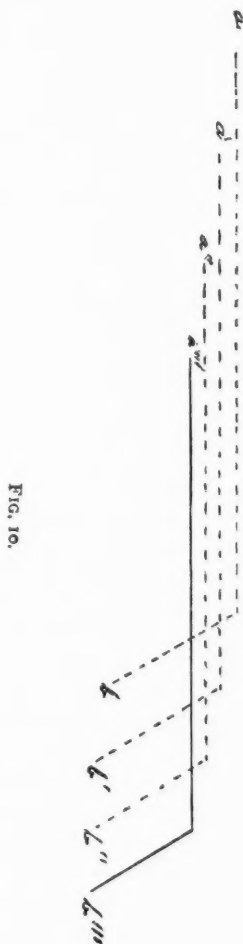
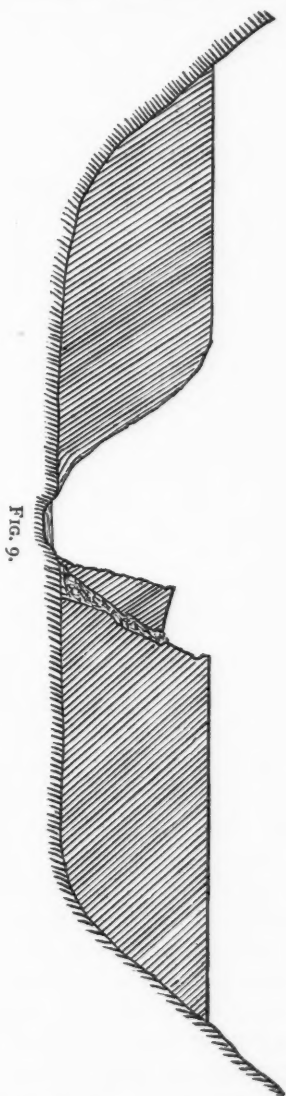
The earth is obtained from an excavation at the left and carried to the right, so that the oblique stratification will dip to the right, as shown in Figs. 7 and 8. The bank on the right side of the "washout" would have to break across the line of the oblique stratification, hence it would project, or "overhang," as a precipice, while the opposite side would break more with these strata, would be inclined to slope, as illustrated in Fig. 8.

In the course of a year or so the right bank would break and drop down in falls, and the left would gradually and imperceptibly slide like soft putty, and form a slope as shown in Fig. 9.

Where a bank is built by pouring the earth over the end or side, it will continue to slide in that direction long afterward. I think every engineer of much experience will agree to this. This bank, as shown in Fig. 9, shows the same condition we find in the north and south-facing hills in the drift region, the left side representing the south-facing hill.

Flood plains, or bottoms of streams are deposited in this order: The bars at their up-stream ends are level with low water, and even extend up stream under the water, while at their down-stream end they are elevated as high as the older bottom land, a part of which they ultimately become. The swiftest current is at the

upper end of these bars, consequently only the heaviest pebbles



are dropped there ; the next heaviest being dropped next farther down, and so on to the lower end where the bars always termi-

nate in fine sand, with a pour over the end as shown in the railroad embankment in Figs. 7 and 8, and more definitely in Fig. 10.

In Fig. 10 the dotted line, *a b*, shows the longitudinal section of the bar, as left by the last preceding flood. The line, *a' b'*, shows it as left by the next succeeding flood, and the lines *a'' b''* and *a''' b'''* show the conditions after still later floods. Hence bars and bottoms are always building down stream and being worn away at their up-stream ends. While they are, in *fact*, deposited in an oblique order, it is rarely that the eye can detect it in a longitudinal section of the bottom.

A bottom built in this order would be expected to have a sliding tendency like the straw stacks and railroad banks before mentioned. The fact that the trees which grow thickly over the bar



FIG. 11.

over *b b' b''* and *b'''*, at first grow with the plumb line, and begin to lean down stream with age till the grown ones lean from ten to forty degrees, is clear proof to me that the newly deposited bottoms slide like a glacier, obeying the same law of motion, but greatly slower of course. The surface moving faster than the bottom, would incline the trees. If the bottom (flood plain) should slide one foot in fifty years, it would be sufficient to produce the result we see. The trees do not get their inclination from the pressure of the floods. These bottom trees grow rapidly, and in ten years are able to withstand the floods. Beside, the current is always weak at the lower end of the bars. Eddies generally prevail there, otherwise there would be no sediment dropped.

When a growing tree is bent or inclined, it makes an effort to

grow vertical from that time (and point) upward, and at maturity shows the curve and tangent as in Fig. 11.

Nearly all the trees growing on the down-stream end of bottoms, show the lean as in Fig. 11, and some show the bend at the bottom. The young trees, at ten years, show very little inclination as compared with the grown and old ones.

I saw a case in the north-east part of Brown county, before mentioned, on the south side of Jesse Walker's farm (section, township and range forgotten), where a "worm" rail fence had been built on the south boundary line across the bottom of a small stream or brook, the bottom not over 300 feet across. The fence had been built straight, and about eight rails high. The sediment carried from the fields on the adjacent hills during rains, was caught by the grass and so silted up that the bottom rails were submerged. The proprietor kept adding rails to the top as fast as they were submerged at the bottom, so as to keep the necessary height of fence. This continued about fifteen years, when the original eight rails had been entirely covered or submerged, when it was noticed that the fence had been swayed down stream about four to five feet from the original straight line. The sedimentary deposit had certainly moved like a glacier. This coincides with the other facts before stated.

In conclusion, the drift was deposited here by the waters from a receding glacier. The general course of the flow, as indicated by the striations, was about south  $15^{\circ}$  to  $18^{\circ}$  west. If my theory is correct, the tendency of the deposit of the drift would be to slide southward. I do not wish to be understood as confidently affirming the correctness of my theory, but that the slope of the hills, the lean of the trees on south-facing hills, taken in connection with the other facts I have cited, strongly suggest my theory as the explanation of the facts. If this theory does not explain the phenomena, what other does? Are there any well-established facts which contradict this theory? If so—what?

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## RENUMERATION OF THE SPINAL NERVES AND RECONSTRUCTION OF THE PLEXUSES IN THE HUMAN SUBJECT.

BY DR. ELLIOTT COUES.

THERE being a pair of spinal nerves to each vertebral interspace down to the coccyx, and the pair counted first being

*above* the first cervical vertebra (between atlas and occiput), it obviously follows that the seventh cervical pair is *above* the seventh cervical vertebra. There being but seven cervical vertebræ, "eight cervical nerves" cannot properly be said. For the nerve enumerated and known as "eighth cervical," issuing as it does *above* the first dorsal vertebra, is actually first dorsal, according to the count we start with.

If we agree in the beginning to number and name spinal nerves by the number and name of the vertebra next *below* each one of them, then to reckon eight cervical nerves to seven cervical vertebræ sets the whole series of succeeding nerves wrong by one. The irregularity is obvious, requiring no comment; but how it was brought about is not explained in the ordinary text-books, and the student learns the plexuses with difficulty, instead of with the ease with which he can be taught to know them if the nerves which enter into their composition be counted correctly. Sufficiently complicated as it is at best, the matter may nevertheless be much simplified by a fair count.

The case affords a curious instance of survival of the *unfittest*—a singular oversight of early anatomists having been perpetuated to the present day, and become ingrained in the established numbering and naming of the spinal nerves as grouped into cervical, dorsal, lumbar, sacral and coccygeal sets. It arose in this way: When the cranial and spinal nerves were numbered, the true first spinal (suboccipital, between occiput and atlas) was reckoned a *cranial* nerve; then that one which issues *below* the atlas (between atlas and axis) of course became "first cervical," and succeeding ones were numbered consecutively, that one which issues *below* the seventh cervical vertebra being of course "seventh cervical." Next, when the cranial nerves were revised, the suboccipital was correctly excluded from the cranial set and included in the spinal series, being added of course to the cervical nerves. Thus there then came to be "eight cervical" nerves, for the same lower limit of the "cervical" series was retained. But their collective number and their respective numbers being each raised by one nerve, it was as if their respective positions had each dropped down one vertebra; so that, for example, what had before been seventh and last cervical nerve became then "eighth" and last (between last cervical and first dorsal vertebra). Strangely enough, however, the other spinal nerves were left as

they had been before, the renumeration required to shift the several sets into proper position not having been made. Hence arose that irregularity which has doubtless tried the wits of many a student, puzzled to discover how there can be reckoned *eight* cervical nerves to *seven* cervical vertebræ, though there is one nerve apiece to the dorsal, lumbar and sacral vertebræ, and yet no break in the whole series; how it can be that the first cervical nerve issues *above* the first cervical vertebra, yet the last cervical nerve issues *below* the last cervical vertebra; how it can be a *second* cervical nerve which issues between the first and second cervical vertebræ, yet a "*first dorsal*" which issues between the first and second dorsal vertebræ; and so forth. There is evidently something wrong about this; yet it has become so thoroughly ingrained in our nomenclature and descriptions of these nerves, that a very poor piece of arithmetic somehow looks like a necessary anatomical fact.

The required correction is self-evident, and wrong numbering is very easily rectified. To make the count straight we have only to do for the dorsal, lumbar, sacral and coccygeal nerves what was done for the cervical when the suboccipital was added to that series—drop them all down one vertebra or, what is the same thing, raise them all up one number.<sup>1</sup> Just as what had been in the first place first cervical nerve has now become second cervical, and what had been seventh cervical nerve became eighth cervical; so now, what has hitherto been eighth cervical nerve (8th of the whole series) becomes first dorsal; what has been twelfth dorsal (20th of the whole series) becomes first lumbar; what has been fifth lumbar (25th of the whole series) becomes first sacral; what has been fifth sacral (30th of the whole series) becomes first coccygeal, and what has been first and last coccygeal (31st of the series) becomes second and last coccygeal (see table at end). Of course neither the total of the spinal nerves (31), nor the several sums of the sets of dorsals (12), lumbar (5) and sacrals (5) is altered; but there are seven instead of eight to be reckoned cervicals, and two coccygeals instead of one; and the boundaries of each of the sets shifts up one vertebra. By this simple rectification every spinal nerve is regularly numbered and named by the vertebra *above* which it issues (since

<sup>1</sup>A nerve is *raised* numerically when, *e.g.*, a sixth becomes a seventh; but it is then *lowered* in position.

we begin that way), instead of being reckoned irregularly, sometimes by the vertebra above it, sometimes by the vertebra below it; and the sets of nerves are all brought into uniform relation with the sets of vertebræ, from occiput down to coccyx. The difference between the reckoning hitherto in vogue and that now proposed may be easily brought to the eye. In the following examples of old and new styles the letters are the vertebræ, the lower figures being their own numbers, but the upper figures are the numbers of the nerves; thus  $^8d_1$  is first dorsal vertebra and so called eighth cervical nerve. It will be seen that in the first row no numbers correspond with those of vertebræ after  $^7c_7$ , and that in the second row all the numbers correspond as long as nerves hold out. It will also be seen that the lumbar and sacral plexuses are out of order with their respective vertebræ in the first row; and that in the second row the change in numeration brings these plexuses into order with their respective vertebræ (the composition of plexuses being of course the same in either case):

	cv. plex.	brach. plex.	intercostal nerves.
Old style—	$^1c_1, ^2c_2, ^3c_3, ^4c_4, ^5c_5, ^6c_6, ^7c_7$	$^8d_1, ^1d_2, ^2d_3, ^3d_4, ^4d_5, ^5d_6, ^6d_7, ^7d_8, ^8d_9, ^9d_{10}, ^{10}d_{11}, ^{11}d_{12}$	
New style—	$^1c_1, ^2c_2, ^3c_3, ^4c_4, ^5c_5, ^6c_6, ^7c_7$	$^1d_1, ^2d_2, ^3d_3, ^4d_4, ^5d_5, ^6d_6, ^7d_7, ^8d_8, ^9d_9, ^{10}d_{10}, ^{11}d_{11}, ^{12}d_{12}$	
	cv. plex.	brach. plex.	intercostal nerves.
	lumb. plex.	sacr. plex.	
	$^{12}l_1, ^{11}l_2, ^{10}l_3, ^9l_4, ^8l_5$	$^6s_1, ^1s_2, ^2s_3, ^3s_4, ^4s_5$	$^5c_1, ^1c_2, ^0c_3, ^0c_4$
	$^1l_1, ^2l_2, ^3l_3, ^4l_4, ^5l_5$	$^1s_1, ^2s_2, ^3s_3, ^4s_4, ^5s_5$	$^1c_1, ^2c_2, ^0c_3, ^0c_4$
	lumb. plex.	sacr. plex.	

It is incumbent upon one who proposes innovations to show good reason for interfering with established usages. In the present case it will be found, on sufficient examination, that not only is the numeration of the spinal nerves properly regulated, so that the several sets of nerves coincide with the sets of vertebræ, but also that the construction of the plexuses may be much more easily appreciated and much more simply described after than before this rectification is made. Moreover, without altering the recognized limits and composition of the plexuses in the least particular, we make them seem much more naturally constructed by simply correcting the numeration of their respective nerves.

Furthermore, the proposed rectification is equally available for other animals than man; and in these it is highly desirable to

have some fixed method of counting nerves, especially those which compose plexuses, with reference to their distribution in cervical, dorsal and other sets. If we agree to know and name any spinal nerve *by the vertebra above which it issues*, we can hardly go astray.

The principal points touching the plexuses of the human subject may be noted in comparing the old with the new style.

1. The cervical plexus is not affected (first four cervical nerves).

2. The brachial plexus falls between the cervical and dorsal sets of nerves in either case, but there is a distinction in favor of the new numeration. The plexus is said to be formed by the last four cervical (5th-8th) and first (1st) dorsal nerves; and it is said that three of the cervical (5th-7th) unite to form the upper cord, while the last (8th) cervical and first (1st) dorsal unite to form the lower cord. I should say that the brachial plexus is formed by the last three (5th-7th) cervicals and first two (1st-2d) dorsals, the former uniting in one cord, the latter in another. Thus the remarkable partition of the brachial plexus into two cords, which extend to the axilla, coincides with its derivation from the two sets of nerves; and further details, such as the union of the two dorsals as soon as they leave their respective foramina, show that the division of the two sets of nerves here made is the natural one.

3. The so-called last (12th) dorsal or intercostal nerve (that issuing between the last dorsal and first lumbar vertebra) is generally noted in the text-books for various peculiarities which relate it to the lumbar series, besides its actual connection with the latter. This nerve is really first (1st) lumbar. The lumbar plexus is variously described as consisting of the last dorsal (12th) and four (1st-4th) or five lumbar nerves (1st-5th), according to whether or not its sacral connection is taken into account. I should say simply that the lumbar plexus is formed by the five lumbar nerves proper (1st-5th), with communicating loop to the sacral plexus. Matters are here greatly simplified by the renumeration. It is well to remember that *all* contiguous plexuses have a communicating loop, both above and below; thus there is one between the cervical and brachial, and one between the lumbar and sacral; but such loops separate plexuses as well as connect them.

4. Another good effect of the renumeration is, that the great nerve called fifth lumbar, issuing between the last lumbar and first sacral vertebræ, and so remarkably distinguished from the rest in size and disposition that is already known as the "lumbo-sacral cord," is taken out of the lumbar series altogether and put where it belongs, in the sacral series, as first sacral. The sacral plexus is commonly said to be formed by the lumbo-sacral cord (5th lumbar) and the four upper sacral nerves (1st-4th) which issue from the completed anterior sacral foramina, or by these and the next nerve below. I should say simply that the sacral plexus is formed by the five (1st-5th) sacral nerves proper. There is of course the loop of communication with the lumbar, as above said, and there is also connection with the coccygeal nerve or nerves; but these are not to be taken into account in defining the plexus. The natural division of this very large but comparatively simple plexus is not into a lumbo-sacral cord (1st sacral) *and* four (2d-5th) sacral nerves, but into the four great upper nerves (1st-4th sacral proper) and the much smaller (5th) sacral one.

5. The remaining very diminutive nerves are connected with the preceding. There being no inter-coccygeal foramina, they are obliged to appear together between the sacrum and coccyx. Nor are they constant in appearing. It is scarcely material whether we consider them merely tributary to the great sacral plexus, or together forming a little coccygeal plexus. I believe it is customary to take them into the sacral plexus, in which case this great plexus is made up of four large cords and two little ones, and a single coccygeal is left alone. The chief point is here, that any nerve or nerves issuing between the sacrum and coccyx must be coccygeal, whether there be one or two, and whatever disposition be made of it or them.

To strip the subject of verbiage as far as possible, I have spoken of the plexuses as formed by the nerves. It is of course understood that I mean their anterior branches in every case. Intercommunications between posterior branches of spinal nerves are not generally treated as plexuses, unless it be those between the 1st-3d cervicals, which some writers formally recognize by such name. The same may be said of connections between cranial and spinal nerves, as that of the hypoglossal. Nor are any of the sympathetic plexuses here brought into question.

It remains to formally tabulate the renumeration of spinal nerves and the reconstruction of the plexuses which I recommend for adoption :

OLD STYLE.				NEW STYLE.			
Plexus, Cervical [Four]	{	N. Cervical First.	1	1. First Cervical N.	{	Cervical Plexus [Four]	
		" " Second.	2	2. Second " "			
		" " Third.	3	3. Third " "			
		" " Fourth.	4	4. Fourth " "			
Plexus, Brachial [Five]	{ [cord, upper]	" " Fifth.	5	5. Fifth " "	{ [upper cord]	{ Brachial Plexus [Five]	
		" " Sixth.	6	6. Sixth " "			
	{ [cord, lower]	" " Seventh.	7	7. Seventh " "	{ [lower cord]		
		" " Eighth.	8	8. First Dorsal N.			
		N. Dorsal First.	9	9. Second " "			
Intercostals [Ten]	{	" " Second.	10	10. Third " "	{	Intercostals. [Ten]	
		" " Third.	11	11. Fourth " "			
		" " Fourth.	12	12. Fifth " "			
		" " Fifth.	13	13. Sixth " "			
		" " Sixth.	14	14. Seventh " "			
		" " Seventh.	15	15. Eighth " "			
		" " Eighth.	16	16. Ninth " "			
		" " Ninth.	17	17. Tenth " "			
		" " Tenth.	18	18. Eleventh " "			
		" " Eleventh.	19	19. Twelfth " "			
Plexus, Lumbar [Five]	{	" " Twelfth.	20	20. First Lumbar N.	{	Lumbar Plexus. [Five]	
		N. Lumbar First.	21	21. Second " "			
		" " Second.	22	22. Third " "			
		" " Third.	23	23. Fourth " "			
		" " Fourth.	24	24. Fifth " "			
[Lumbo- Plexus, Sacral]	{ [sacral cord] large	" " Fifth.	25	25. First Sacral N.	{ large	{ Sacral Plexus [Five]	
		N. Sacral First.	26	26. Second " "			
	{ small	" " Second.	27	27. Third " "	{ small		
		" " Third.	28	28. Fourth " "			
		" " Fourth.	29	29. Fifth " "			
		" " Fifth.	30	30. First Coccyg. N.			
	N. Coccyg. First.	31	31. Second " "				

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## A REVIEW OF THE PROGRESS OF NORTH AMERICAN INVERTEBRATE PALÆONTOLOGY FOR 1883.

BY J. B. MARCOU.

I HAVE taken up the task of preparing this brief review at the request of Dr. C. A. White, who, for several years past, has prepared a similar one, but whose numerous avocations do not leave sufficient time for continuing his publication of such a review.

During the latter part of the year invertebrate palæontology

has lost two of its most eminent students, Professor Oswald Heer, of Zurich, whose descriptions of the cretaceous dicotyledons of Nebraska and of the arctic flora, assure him a prominent place among the pioneers of American palæontology; and Mr. Joachim Barrande, whose publications of a number of our older fossils also entitle him to a prominent place in the history of the progress of North American palæontology.

At the meeting of the American Association for the Advancement of Science for 1883, a number of palæontological papers were read, of which brief notices appeared in *Science*, Vol. II, No. 31. Professor James Hall read a paper entitled "Preliminary note on the microscopic shell structure of the paleozoic Brachiopoda." Professor J. W. Dawson read a paper on "Rhizocarps in the paleozoic period." Mr. E. W. Claypole read a paper on "Renssæeria and a fossil fish from the Hamilton group of Pennsylvania," he also read a paper on "A large crustacean from the Catskill group of Pennsylvania."

H. Booth, in the *American Journal of Science*, for November, has a note on the "Discovery of Utica slate Graptolites on the west side of the Hudson."

S. Calvin, in the *Amer. Journ. of Science*, for June, published an article "On the fauna found at Lime creek, Iowa, and its relation to other geological faunas." In this article he points out a few errors made by Professor H. S. Williams, in the *Amer. Journ. of Science*, for February, on "The fauna at the base of the Chemung group, in New York." Mr. Calvin, while admitting the similarity of the Lime creek fauna with that of High Point, N. Y., considers their equivalency very doubtful.

John M. Clarke, in the *Amer. Journ. of Science*, for February, published a paper on "New discoveries in Devonian crustacea."

E. W. Claypole, in the *AMERICAN NATURALIST*, Vol. XVII, No. 3, published a paper "On the occurrence of fossiliferous strata in the lower Ponent (Catskill) group of Middle Pennsylvania."

J. W. Dawson, in the *Canadian Naturalist and Quarterly Journal of Science*, Vol. x, New Series, No. 7, has a "Preliminary notice of new fossils from the Lower Carboniferous limestones of Nova Scotia and Newfoundland," in which there are descriptions of six new species from Nova Scotia, and of three from Newfoundland. In No. 8, of the same paper, Professor Dawson has a "Notice of graptolites of the Quebec group, collected by Mr. James Richardson for the Peter Redpath museum." In the *Trans.*

of the Royal Soc. Canada, on May 23d, 1883, he presented a paper on the "Cretaceous and tertiary floras of British Columbia, and the Northwest territory," illustrated by eight quarto plates; he mentions the occurrence of a few plants from the Ft. Pierre group, which are apparently different from a flora found in the same group on the Upper Missouri by Mr. Lester F. Ward in 1883, and yet unpublished.

Walter F. Ferrier, at the fourth meeting of the Natural History Society of Montreal, session 1882-1883 (published in the *Canadian Naturalist and Quarterly Journal of Science*, Vol. x, New Series, No. 8), read his "Notes on a fossil track from the Potsdam sandstone of Northern New York State," and Dr. Dawson said that the impressions belonged to the genus *Gyrichnites*, proposed by J. F. Whiteaves for similar impressions from the Erian of Gaspé.

Wm. F. E. Gurley published his "Bulletin, No. 1, New Carboniferous Fossils;" this is a private publication, apparently printed for private circulation—the descriptions are very indifferent, and the absence of any figures renders it difficult to say whether his species are new or not. It would be well for Mr. Gurley, if he wishes his species to be recognized, to seek publication through some of the regular channels, and to accompany his descriptions with proper illustrations.

Angelo Heilprin, in the Proc. Philadelphia Acad. of Nat. Sciences, published a "Note on a collection of fossils from the Hamilton (Devonian) group of Pike Co., Pennsylvania." This is a list of species and genera identified by Professor Heilprin in a collection made by Drs. E. Hine and J. Holt, and is welcome as a contribution to our knowledge of the palæontology of a State, concerning which we know comparatively little.

*Indiana*.—The twelfth report of the State geologist, Mr. John Collett, contains fourteen plates of the Van Cleve fossil corals, which are on the whole very creditable productions; they were reviewed by Professor James Hall, who also republishes here fourteen plates of his own corals, most of which are referred to as having been published in the advance sheets of the thirty-fifth annual report of the New York State Museum of Natural History (which has not yet appeared), but five of the species were unpublished. The Spargen Hill Brachiopoda, published by R. P. Whitfield, in the Bulletin No. 3, of the Amer. Museum of Nat. Hist., have also been reproduced here.

*Illinois.*—The seventh volume of the geological survey of Illinois contains descriptions of fossil invertebrates by A. H. Worthen, and S. A. Miller, and by Chas. Wachsmuth, and W. H. Barris, illustrated by five plates, together with an article on a new genus and species of Blastoids, with observations upon the structure of the basal plates in Codaster and Pentremites by Chas. Wachsmuth, and descriptions of some new Blastoids from the Hamilton group by W. H. Barris, in which four new species are described. The crinoids described are mostly from the Lower Carboniferous, being from the Keokuk, Warsaw, Chester, and St. Louis groups, with the exception of two or three species from the Upper Carboniferous.

U. P. James, on April 16th, published the seventh number of his "Palæontologist," with illustrated descriptions of three new species of fossil corals from the Cincinnati group of Ohio and Kentucky. In the Journal of the Cincinnati Society of Natural History, Vol. vi, December, he published "Descriptions of fossils from the Cincinnati group," illustrated by one plate, No. x; only two species are described.

Leo Lesquereux, in the proceedings of the U. S. National Museum, Vol. v, pp. 443-449, has published a "Contribution to the Miocene flora of Alaska," illustrated by five plates, vi to x, containing descriptions and figures of some new species, with an enumeration of some species already described, but not yet known in the flora of Alaska.

S. A. Miller, in the *Amer. Journ. of Science*, for August, published a "Response to the remarks of Messrs. Wachsmuth and Springer on the genera Glyptocrinus and Reteocrinus. In the Journal of the Cincinnati Society of Natural History, Vol. vi, December, 1883, he published an article entitled "Glyptocrinus re-defined and restricted, Gaurocrinus, Pyncocrinus, and Compsocrinus established, and two new species described." This article is illustrated by one lithographic plate of indifferent execution.

John Mickleborough, in the Journal of the Cincinnati Society of Natural History, for October, Vol. vi, published an article on the "Locomotive appendages of Trilobites." The specimen described is of great interest, and corroborates the evidence given by the Canadian Asaphus, described by Mr. E. Billings; unfortunately nothing is proven with relation to the oral appendages and branchiæ. The plates or figures, and a portion of the text were republished in the AMERICAN NATURALIST, for December.

J. S. Newberry, in the Proceedings of the U. S. National Museum, Vol. v, pp. 502-514, published "Brief descriptions of fossil plants, chiefly tertiary, from Western North America." No illustrations accompany these descriptions of fossil plants, mostly collected by Dr. F. V. Hayden, though many were collected by Professor T. Condon, by Professor J. J. Stevenson and I. C. Russell. Fuller descriptions with illustrations will appear in a volume which is to form one of the reports of the U. S. Geological Survey.

*New York.*—The second part of Vol. v of the Palæontology of New York, by James Hall, has appeared. It contains descriptions and illustrations of the Gastropoda, Pteropoda and Cephalopoda of the Upper Helderberg, Hamilton, Portage, and Chemung groups, illustrated by a volume of 113 very good plates. Professor Hall has also published a few copies of the plates of part first, of Vol. v, of the Palæontology of New York: "Lamellibranchiata, plates and explanations." There are twenty pages of explanations, and eighty plates of very good drawings, especially those drawn by J. H. Emerton, of Lamellibranchiate shells from the Upper Helderberg, Hamilton, Chemung, and Waverly groups, Professor Hall still retaining the latter group in the Devonian. "The author has been allowed to purchase, from the Secretary of State, 100 copies of the plates already lithographed, for this volume, which are published in this form in order to make them available for the use of scientific institutions and students in palæontology. The text and additional plates of the volume, whenever published, will be sent to the parties receiving this portion of the work."

S. H. Scudder, in the Proceedings of the American Academy of Arts and Sciences, presented on October 10th, a paper on the "Fossil white ants of Colorado from Florissant;" six new species and one new genus are described; and Mr. Scudder argues that their presence at Florissant is indicative of a much warmer climate than the locality now enjoys.

R. E. C. Stearns, in the AMERICAN NATURALIST, Vol. xvii, No. 10, published an illustrated paper "On the shells of the Colorado desert and the region farther east."

E. O. Ulrich, in the Journal of the Cincinnati Soc. of Nat. Hist. for April, 1883, No. 1, p. 82, and for July, 1883, No. 2, p. 148, published his "American palæozoic Bryozoa." (Continued from Vol. v, 1882, p. 297.)

The twelfth annual report of the U. S. Geological and Geographical Survey of the Territories, by F. V. Hayden, contains "Contributions to invertebrate palæontology," Nos. 2-8, by Dr. C. A. White, an author's edition of which appeared in (July) 1880. It also contains a brief article on the "Palæontology of the Florissant basin," by S. H. Scudder, which is a reprint with additions and illustrations of the article published in the Bull. of the Survey, Vol. VI, Art. XI. It also includes a monograph of the North American Phyllopod Crustacea, in which the fossil Phyllopoda and Phyllocarida are enumerated.

Charles Wachsmuth and Frank Springer, in the *Amer. Journ. of Science*, for April, published "Remarks on *Glyptocrinus* and *Reticocrinus*, two genera of Silurian crinoids." The same authors, in the November number of the same journal, published an article on "*Hybocrinus*, *Hoplocrinus*, and *Bærocrinus*."

M. E. Wadsworth, in *Science*, Vol. I, p. 422, published a note on "Molluscan rock-boring."

C. D. Walcott, in the advance sheets of the thirty-fifth report of the N. Y. State Museum of Natural History, published "Descriptions of new species of fossils from the Trenton group of New York," illustrated by one plate, No. XVII. In the *Amer. Journ. of Science*, he published a note on the "Injury sustained by the eye of a trilobite at the time of the molting of the shell." In *Science*, Vol. II, No. 46, p. 808, the same author published "Fresh-water shells from the palæozoic rocks of Nevada." This is a brief illustrated note of three new species, and one new genus of shells from the carboniferous strata of Nevada.

L. F. Ward, in *Science*, Vol. I, p. 358, published a brief article on "Plant life, past and present."

C. A. White, in the *AMERICAN NATURALIST*, Vol. XVII, No. 6, published his "Progress of invertebrate palæontology in the U. S. for the year 1882." In the *Amer. Journ. of Science*, for March, he published "Late observations concerning the molluscan fauna and the geographical extent of the Laramie group;" in the same journal for August, he published a note on the "Commingleing of ancient faunal and modern floral types in the Laramie group." Dr. White has also published, in the annual report of the U. S. Geological Survey, 1881-1882, separately paged, with 32 plates, "A review of the non-marine fossil mollusca of North America." It is an important and lasting contribution to North American pal-

æontology in a very useful form. In his preliminary remarks, Dr. White calls attention to his original view of the origin of non-marine mollusks, through the land-locking of marine types, and derives our present non-marine fauna of the Mississippi drainage system directly from the fauna of the old Laramie sea. In the Proceedings of the U. S. National Museum, Vol. v, pp. 94-99, Dr. White published, "New molluscan forms from the Laramie and Green River groups, with discussion of some associated forms heretofore known," illustrated by two plates, Nos. III and IV; these descriptions already appeared in his review of the non-marine fossil mollusca of North America. In the same publication, pp. 99-102, he has also "The molluscan fauna of the Truckee group, including a new form," illustrated by one plate, No. v; this also appeared in the review of non-marine mollusca.

J. F. Whiteaves, in the *Canadian Naturalist and Quarterly Journal of Science*, Vol. x, new series, No. 7, published a note on the "Occurrence of *Siphonotreta scotica* (Davidson), in the Utica formation, near Ottawa, Ontario." This paper was read before the American Association for the Advancement of Science, Montreal, 1882.

R. P. Whitfield, in the *Amer. Journ. of Science*, for May, published "Observations on the fossils of the metamorphic rocks of Bernardstown, Mass."

H. S. Williams read before the American Philosophical Society, April 20th, 1883, a paper on "A crinoid with movable spines." In the Proceedings of the Academy of Natural Science of Philadelphia, Part I, 1882, p. 17, Professor Williams published "New crinoids from the rocks of the Chemung period of New York State," illustrated by one plate, No. 1. In the *Amer. Journ. of Science*, for February, Professor Williams published a paper on the "Fauna at the base of the Chemung group in New York," in which he gives a list of species found at High Point, Naples, N. Y., and comments on their similarity to the fauna of Lime creek, Iowa, referring it to the Kinderhook group, and argues that they are equivalent, and that as long as the Chemung is to be retained in the Devonian, the western beds should also be regarded as Devonian; he has apparently overlooked Professor S. Calvin's article in the *Amer. Journ. of Science*, 1878, Vol. xv, p. 460, in which the species mentioned are recorded as occurring also at the base of the Devonian in Iowa, showing them to have

a wide vertical range, and bearing out Dr. White's view, that the Devonian of Iowa belongs to a single epoch, probably the Hamilton. In the *Amer. Journ. of Science*, for April, p. 311, Professor Williams, in a note, acknowledged that he was wrong in speaking of the rocks of Lime creek, Iowa, as referred by Western geologists to the Kinderhook group, but maintained his view, that its fauna was represented in N. Y., at the base of the Chemung.

*Wisconsin.*—Vol. IV, Part III, of the Geological Survey of Wisconsin, contains descriptions of fossils, by R. P. Whitfield, illustrated by 27 plates of very good figures; some of the species are new, but most of them have already been described; the fossils described are not offered as a complete representation of the fauna of the several geological horizons of the State, but only as a few of the more prominent known species, together with some of the most characteristic new ones of the several localities from which they have been obtained; the volume also contains a general list of the fossils recognized within the State, including those described, and showing the formation in which they occur, which are the Potsdam, Lower Magnesian, Trenton, Galena, Hudson River, Niagara, Guelph, Lower Helderberg, and Hamilton. Professor Whitfield calls attention to the marked differentiation of the species of the Potsdam in different localities, according to the change in the lithological character of the matrix.

The first volume of the Wisconsin Geological Survey, which has been the last to appear, also contains a list of Wisconsin fossils, and in the general geology contained in the report, there are a large number of figures, many of which are reproductions of Professor Whitfield's plates; the other figures are compiled from various sources, and answer their purpose for a school textbook fairly well.

If those who notice them, will kindly call my attention to any omissions, I will insert them in next year's review, as it is intended to make this record as complete as possible.

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#### EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

— Professor Martin's address at the opening of the new biological institute at Baltimore, lately published in *Science*, calls attention emphatically to the lack of consideration and support

given to physiology in this country. This science is the basis of all sound medical practice, and the time cannot now be far distant when every reputable medical school will be forced to seek a professional physiologist to enroll among its professors. Few departments of science have changed more fundamentally within recent years than physiology. It is not long since it was barely more than a series of anatomical deductions enriched by a slight knowledge of the functions of organs, whereas it is now an exact and experimental science, which employs both the apparatus of the physicist and the reagents of the chemist as well as many instruments adapted to its own special needs, and which can be carried on only in the laboratory. Dr. H. P. Bowditch established at the Harvard Medical School the first well-equipped physiological laboratory in the country, and the example then set has since been followed elsewhere. It is to be hoped that the ample endowment of the Johns Hopkins University will be in part used to enable Professor Martin to develop his laboratory to the highest standard, and that it may exert a far-reaching influence towards promoting not only pure but also medical science, so that it may never fall behind its competitors, but become the worthy compeer of the Harvard laboratory. But while we welcome the auspicious opening of this department of the young university at Baltimore, we cannot escape a feeling of regret that the professor of biology, instead of aiming first at a secure position in medical physiology, even at the sacrifice of much else in biology, should not have fixed upon a higher ideal more worthy of a great university. Morphology, botany, general physiology and biology are all to wait, content to be the handmaidens of medical physiology. The magnificent opportunity to accomplish the immediate development of a school of scientific biology has been deliberately renounced. We deplore what we consider a serious mistake, and are unable to justify the postponement of proper university work in order to favor one class of professional men. Professor Martin's address must, we fear, disappoint many of the high hopes raised by the early aspirations of the Johns Hopkins University. It is too explicit a statement of a purpose too one-sided.

— For many years a number of the scientific members of the Philadelphia Academy of Natural Sciences have endeavored to preserve the institution for the use of a high standard of orig-

inal research. They long since foresaw what has many times been demonstrated, that its present organization means destruction to all important scientific work, and the substitution therefor of the mediocrity of the debating society. They have seen the inevitable amateurism of an unlimited membership gradually asserting itself in a neglect of the principal sources of scientific prosperity. With inconceivable apathy a few of the scientists of the academy have permitted this state of things to continue, when a little activity on their part would have turned the scales in favor of reform. Little help in this direction has been derived from outside the institution, for the public at large do not know the meaning of the words "original research," nor the importance of the ends attainable by it. Recently one or two of the younger specialists, imagining that their personal interest will be better served by joining the "popular" element, have abandoned the project of reform. This action on their part settles the near future of the institution. The only anxiety we feel is lest it receive gifts of money which may not be specifically applied to purposes of original research. If the use of such gifts be not so designated, they will not be directed to the uses for which the academy was created.

In view of this indefinite postponement of the development of this institution, various substitutes are now agitating the minds of some Philadelphians. One proposition is the creation of a school of biology, where research and teaching may be combined in a laboratory. Discussion of this plan has resulted in its adoption by some of the friends of the University of Pennsylvania, and there is considerable ground for hope that such a department of biological research, in connection with that institution, will receive an endowment. One objectionable feature in this scheme is the proposed directorship by one man. There should rather be several directors or professors, each in charge of a department. One man will necessarily be biased in the direction of his own specialty, and others will be more or less neglected. It is true that the chairs necessary for the conduct of a biological school exist in the academy, but so long as their occupants are excluded from the council of that body, competent men cannot be expected to hold them permanently.

Another organization is suggested, which shall represent in this State and city the academies of science of other countries. About twenty men are now living in this State who are distinguished for original researches in various fields of pure science. Such a body would supply a felt want, and its management would be free from the objectionable features which depress the prosperity of existing institutions. It would not probably be long without both museum and library. It is well known that the Academy of Natural Sciences is not likely to be the recipient of important collections under its present organization. It is also true that the

publications of the leading twenty scientific men of Pennsylvania would secure a magnificent return in exchanges for its library.

— We inform interested persons, that the *NATURALIST* does not publish long obituaries; also, that no obituary notices of scientific men of a length of a page or less, has ever been declined by its editors.

—:O:—

### RECENT LITERATURE.

RYDER'S OBSERVATIONS ON EMBRYO FISHES.<sup>1</sup>—The Bulletin of the United States Fish Commission contains a series of articles upon various matters connected with the development of fishes, embodying the results of the investigations of Mr. J. A. Ryder during the year 1882.

The mode of absorption of the yolk of the embryo shad differs in the absence of a vitelline circulation from that which obtains in *Tylosurus* (Belone), *Fundulus*, *Esox*, and *Salmo*. The great mass of the yolk in the shad embryo consists of coarse, irregular masses of very clear protoplasmic matter, separated by a protoplasm which is optically different. The covering of the yolk is a palish amber-colored layer, quite different from the clear body of the yolk, and usually thicker at the end next the heart. The intestine lies in a longitudinal furrow on the dorsal aspect of the yolk-sac, and is never connected with it in this species. The yolk-sac is surrounded by a space filled with serous fluid. This space is capacious anteriorly, between the heart and the yolk, and this part is identified by Mr. Ryder with the segmentation cavity. The delicate pericardial membrane that separates this cavity from the pericardial space may, possibly, be perforate. In *Tylosurus* the two cavities are certainly connected. The heart opens freely into the segmentation cavity, and the appearance presented is that its persistent pulsation breaks up the yolk-substance into small spherules, sucks them out of the segmentation cavity, and carries them into the body of the embryo. The corpuscles develop on the surface of the outer yolk-layer, and after a while drop into the serous fluid, appearing like the white blood cells of human blood. As development proceeds, the yolk-sac becomes pointed in front, and the external layer becomes thicker, while the pericardial membrane becomes funnel-shaped to fit the anterior part of the yolk-mass. Before the final disappearance of the yolk, the liver of the young fish becomes more developed, and the portal vein makes its way over the dorsal aspect of the yolk towards the venous end of the heart. As the peculiar amber layer around the yolk persists to the last, it is probable that the central clear portion is transformed gradually into it.

<sup>1</sup> *Bulletin of the United States Fish Commission*.—Observations on the absorption of the yolk, the food, feeding, and development of embryo fishes, comprising some investigations conducted at the Central Hatchery, Armory Building, D.C., in 1882, pp. 179-205.

This is the history of the yolk-mass after the embryo is hatched, but as it grew in size before hatching, yolk absorption must have taken place before the heart was sufficiently developed to be an active agent in the process. This must be by *intussusception*, and in the amber yolk-covering it is undoubted that a process of cell and blood-cell differentiation takes place. Mr. Ryder concludes that the *hypoblast* of Gensch, said by that investigator to be the source from which the blood is derived, is the equivalent of the amber yolk-covering of the shad, and not the true hypoblast. This amber layer is a temporary structure, which disappears entirely, and does not enter into the formation of any organ or membrane. The serous cavity around the yolk in the shad represents the body cavity, and the outer covering of this, though only  $\frac{1}{200}$  of an inch in thickness, contains epiblast, mesoblast, and hypoblast.

There is practically little difference between the modes of yolk absorption in the chick and in the fish.

A second note refers to some extraordinary hybrids derived from the impregnation of the eggs of the shad with the milt of the striped bass. Many hatched, several lived till they lost their egg-sacs, and about fifty were placed alive in a carp pond. The preponderance of characters was toward the female parent, but the teeth were more numerous and the gape of the mouth wider.

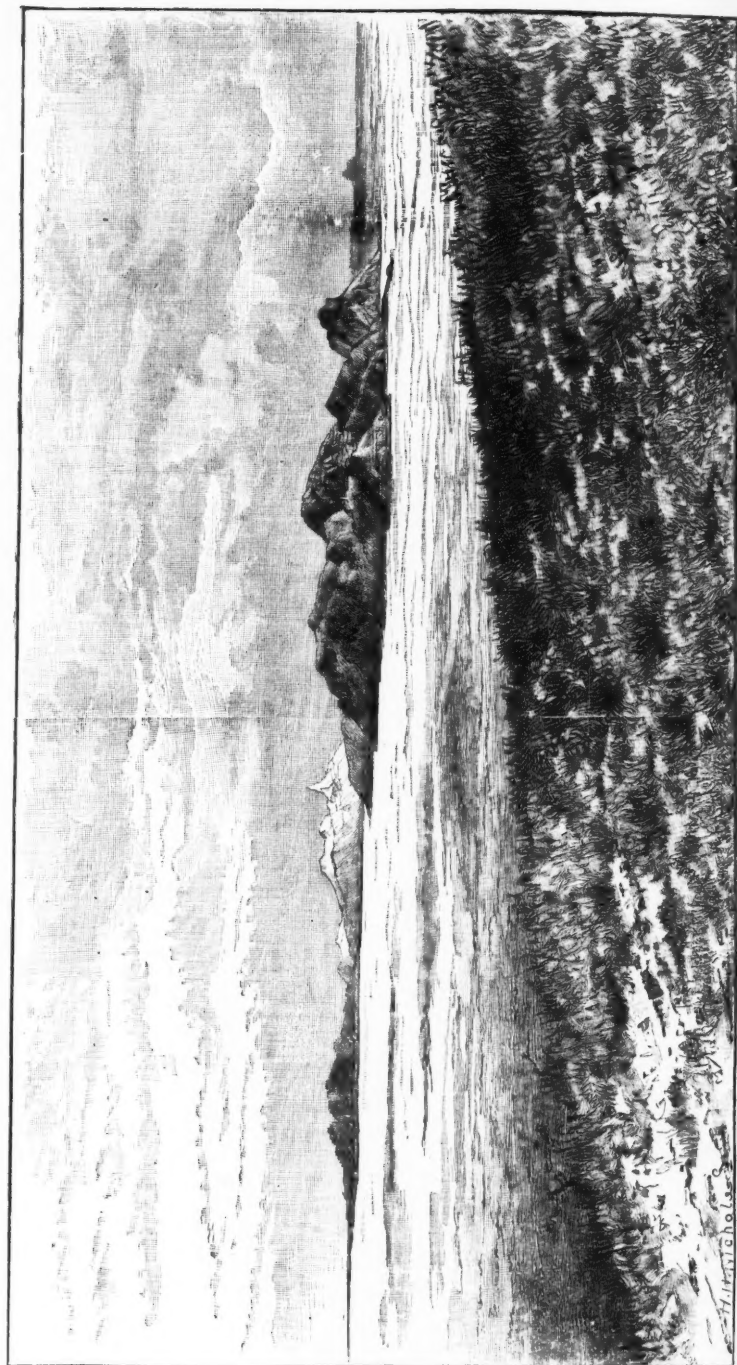
The fungus or alga, that is so fatal to shad eggs, develops wherever there is any imperfection in the circulation of the water. Three forms of glass hatching vessels, the Chase, the Clark, and the McDonald jars, are so arranged that every egg can be kept in continuous gentle movement, while they can be kept free from dead eggs without a skim net. Experiments with carbolic acid, in the hope of eradicating this fungus from the surface of the bodies of some large gold-fish that had become infested with it (probably derived from dead shad-eggs) failed completely. Mr. Livingston Stone states, that a strong solution of salt will kill it, while Mr. Behler recommends a saturated solution of salt water, and states that, if young salmon infested with the fungus are dipped bodily into asphalt, the fungus will be killed, and the young fish come out all right, the asphalt gradually peeling off.

A fifth note relates to feeding young shad with *Daphnidæ*, which, when transferred from the carp-ponds to the aquarium, were observed to die rapidly. The lower temperature may have been a cause, but the principal reason was doubtless the lack of the protozoa, algæ, etc., which form the proper food of the minute crustacea.

Another note refers to methods of handling the adhesive ova of the white perch, and another to the proved destructiveness of sticklebacks to shad larvæ. Twenty-five of these were destroyed in half an hour by four *Apeltes quadricornis*. Both neuropterous



PLATE XIII.



View on Great Salt Lake Desert, showing mountains half buried by lake sediments.

and coleopterous larvæ are also capable of destroying young shad. Transparency is no safeguard against any of these enemies.

Well worthy of the attention of all naturalists are the original observations and categorical facts brought together by Mr. Ryder to prove that there is between ova, even of allied genera, considerable difference, and that at no stage is there a positive identity.

The mechanical construction, as it may be termed, of ova affects the course of their development. The Teleost ovum has a relatively enormous yolk, which must be included by the blastoderm in order to be absorbed, and this relatively large yolk has much to do with the difference observed between its development and that of a Marsipobranch or Amphibian. The eggs of the Salmonidæ have an abundance of oil drops in the vitellus, especially just under the germinal disk. These, by their buoyancy, keep the disk constantly directed upward. The cusk, the crab-eater, Spanish mackerel and moon-fish have eggs which are buoyant from the possession of a single large oil-sphere situated almost exactly opposite to the germinal disk, and thus keeping it face downward—just the reverse of what occurs in the salmonoids. Even after hatching, the young are at first unable to right themselves on account of the presence of the oil-drop. The cod ovum has no oil-drop, yet floats with the germinal disk downwards. That of *Morone americana* (white perch) is adhesive and fixed, with a very large oil-sphere which keeps the disk on the lower side of the vitelline globe. The shad egg is non-adhesive, and heavier than water, and the germinal disk has a constant tendency to arrange itself at the side of the vitellus as viewed from above, though there is no oil to influence it. In *Fundulus* and *Syngnathus* the oil-drops appear uniformly distributed. The number of proto-vertebræ or primary somites differs so much that while *Tylosurus* has as many as seventy-five pairs, *Alosa* has only eighteen to twenty. Our author ventures this bold remark: "When our knowledge is more complete, we shall perhaps be able to distinguish the species apart by the eggs alone, just as botanists have used the characters presented by seeds to distinguish plants."

Not the least of the differences, he truly observes, is form, but we can scarcely follow him to the conclusion that, since "the somewhat similar germs of different animals produce different species, we shall or ought to hold to the doctrine that the protoplasm of which a man is made is different from that of which the body of a dog or fish is composed."

Somewhat similar bricks may be formed into widely different buildings, but it does not follow that the clay differs. The same kind of clay may enter into the grandest erection and the meanest, while two very similar buildings may be made of different clay. Something the same, we conceive, occurs with protoplasm.

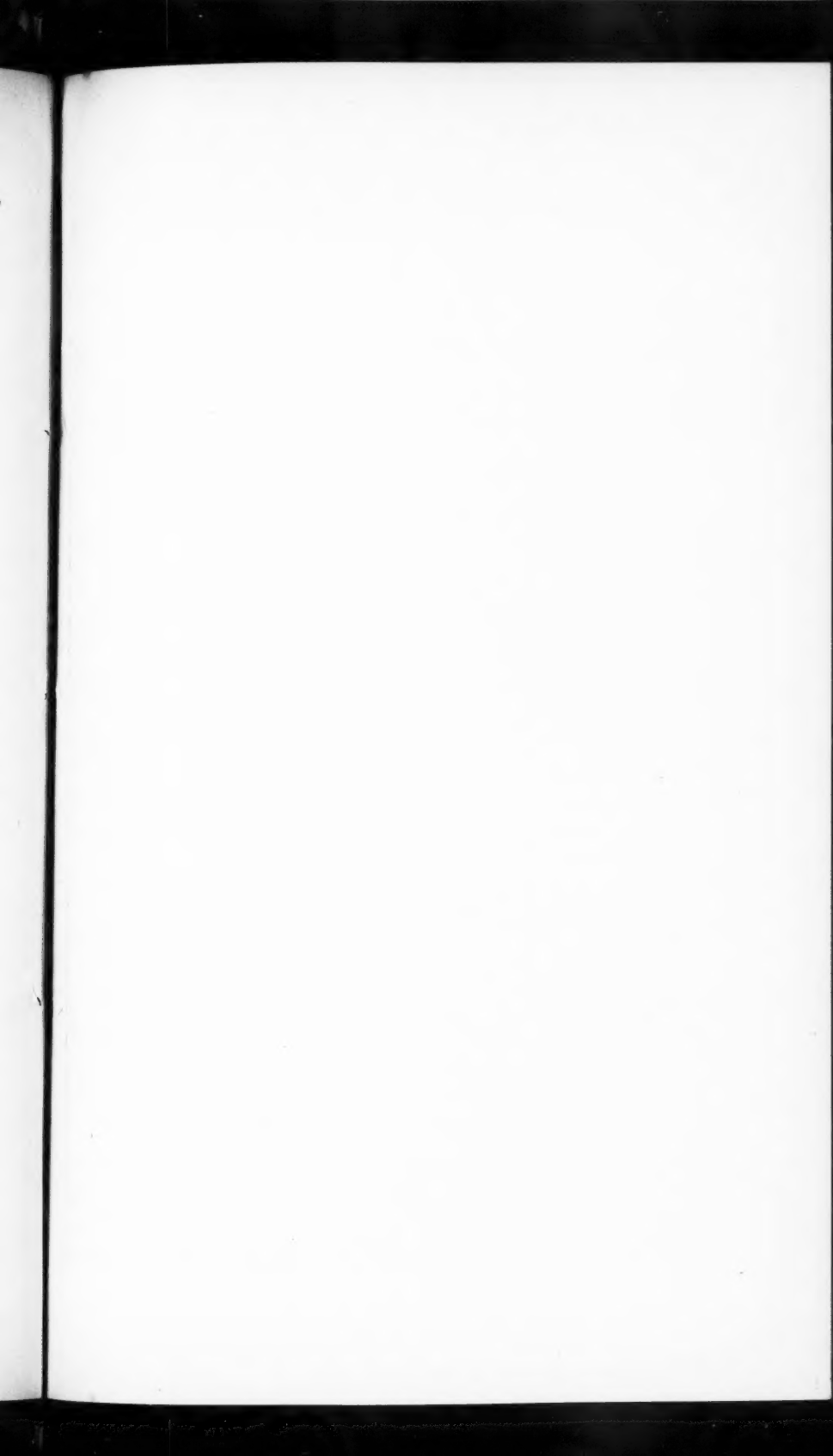
Its chemical constitution may differ, but the difference of animal species is mainly morphological, and there is no reason why different protoplasm may not occur in similar species, while species differing widely morphologically may be formed of similar protoplasm.—*W. N. L.*

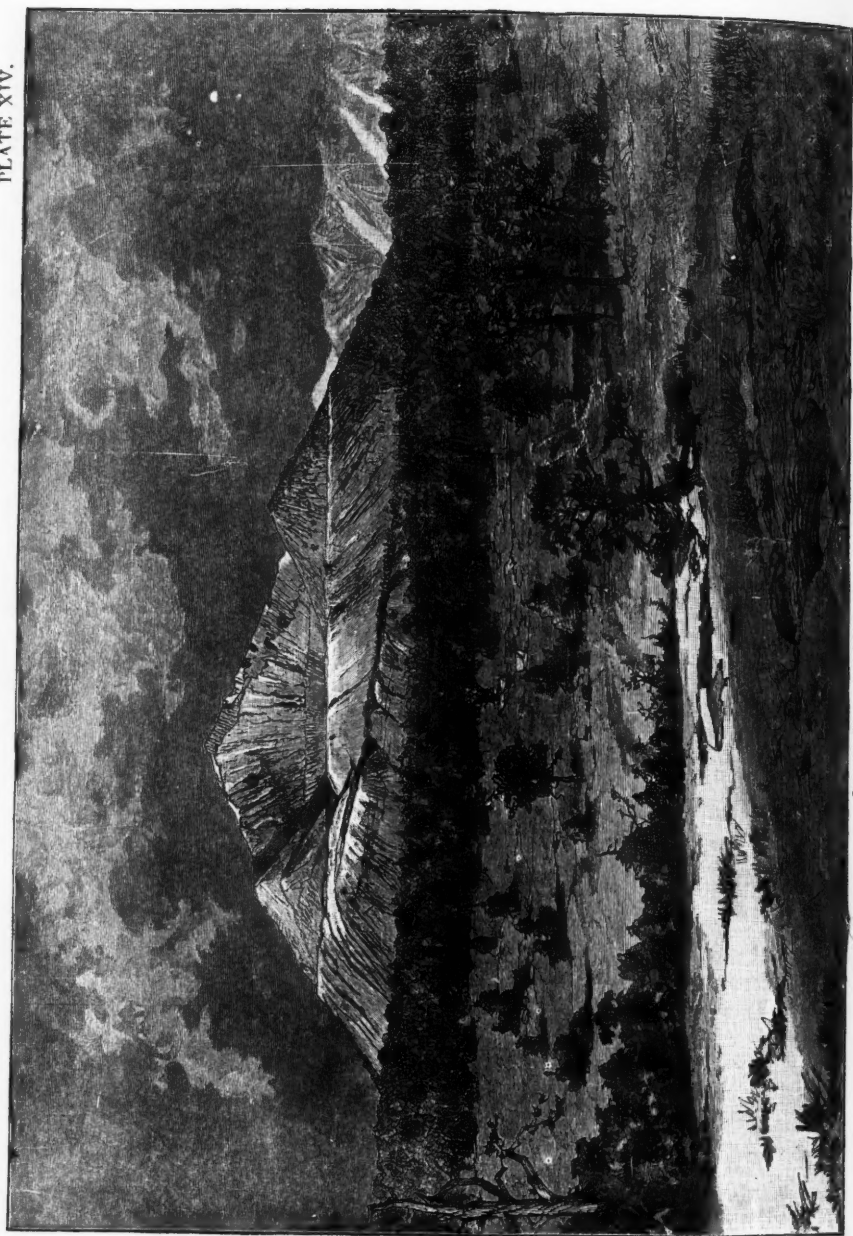
WHITE'S GEOLOGY OF THE SUSQUEHANNA RIVER REGION.<sup>1</sup>—While such a report as this is necessarily filled with details, Professor White has elicited some results (epitomized in the prefatory letter of Professor Lesley) especially bearing on palæontology and glacial geology, which are of general interest. Professor White finds fossiliferous beds high in the Catskill formation, some of the fossils of which appear to be of Chemung type. The discussion of this point is a most interesting one.

The geology of the great terminal moraine, the general course of which is outlined in the prefatory letter of the director of the survey, is discussed. As the ice-sheet, he says, covered the whole country, the high mountain plateaus and the low valleys alike, the moraine is in some places 2000 feet above ocean level, as in the North mountain; in others only 500 feet, as at Berwick. Professor White's observations on the floods of ice-water and the formation of the terrace-plain of part of Columbia county are of much interest.

The limits of the glacial drift in the counties surveyed, are carefully given. "Glacial drift, as a sheet of unstratified sand, gravel and boulders, covers the whole region back of the moraine, and is finally exposed along water-courses. The thickness of this universal mantle of ice-borne trash, brought from the north, is about fifty feet; but where it is banked into the original hollows of the country, filling up ancient river valleys, it is much deeper. \* \* \* Independent observers in other States have assumed fifty feet as about a fair general average thickness for the northern drift over the whole region back of the moraine. If this average be finally accepted, it must set at rest the vexed question of the eroding power of the ice-sheet; for fifty feet of eroded trash carried forward by the ice-sheet can only represent fifty feet (or somewhat less) of mother rock in place. This is an insignificant proportion of the amount of strata (from the coal measures down to the crystalline series) which has been removed from the crust of the earth in the long process of sculpturing the valleys and plains of Pennsylvania and New York, the Great Lake basins and the plain of Canada. Were the average thickness of the drift twice fifty feet, it would be equally true that the erosive power of the ice-sheet has been immensely overrated, and that

<sup>1</sup> *Second Geological Survey of Pennsylvania; Report of Progress G<sup>1</sup>. The Geology of the Susquehanna River region in the six counties of Wyoming, Lackawanna, Luzerne, Columbia, Montour and Northumberland.* By I. C. WHITE. With a colored geological map in two sheets, and thirty-one page plates in the text. Harrisburg, 1883. 8vo, pp. 464.





Facant Bunte, a sublacustrine volcano.

what erosive power it had was exhausted in merely polishing off and putting up the topography of the continent." In this paragraph we have a reiteration of Professor Lesley's well-known views, which, though somewhat extreme, are based, doubtless, on the condition of things in Pennsylvania at the former thin edge of the continental glacier. Where, as in the Great Lake region, the ice was undoubtedly thicker and remained a much longer time, the erosion probably went much deeper. We still greatly need a systematic review of all the facts bearing on the thickness of the morainal matter in different localities over the entire glaciated area of North America. In the Rocky Mountain area most certainly, the amount of erosion and of morainal matter are comparatively slight. The observations which are being made by the Pennsylvania survey are, it seems to us, perhaps more detailed and complete than those of other regions. In the New England States, where the ice lasted longer in the White Mountain region than elsewhere, and where the moraines and ice marks are the most recent, we need far more detailed and connected observations than have yet been made.

To return to our report. From the field work of Professor White, it results that, "Outside, or to the south and west of the moraine, the tops and slopes of the mountains and higher hills of Columbia, Montour and Northumberland counties show no signs of the former presence of ice—no unstratified drift, no ice scratches, no *kames* (formed in ice caverns by subglacial torrents). But the whole country *below* the level of 800', or 750' above tide, is more or less covered with a post-glacial stratified deposit of *modified drift*, derived from the moraine and from the glacial drift which covers the country behind it to the east and north." Here the thought arises, if the immense mass of modified drift has been, as it probably has, "derived from the moraine" to the northward, does not Professor Lesley underestimate the original amount of material removed from the rock surface by the glaciers? Was not the depth of erosion originally more than fifty feet?

Then, in rather more florid language than we are accustomed to meet with in State geological reports, the director goes on to say: "These *post-glacial terrace deposits* are supposed, by Professor White, to mark a flooded river age, beginning with that general rise of the thermometer all over the world, which rapidly melted back the ice-sheet and left the continent in its present genial condition. The winter of the ice age was over; the summer burst upon the world; the mountains appeared again; the valleys were reëxcavated. Unimaginable floods poured southward without cessation along all the valleys, and spread out over the lowlands their burdens of moraine stones, rounded and smoothed by the tumultuous waters. When quieter times came, the Susquehanna river and its affluent streams cut down through these post-glacial deposits, as shown by the terraces which now border their

banks." Here again the inquiry arises, How could these tumultuous, "unimaginable floods" have poured southward "without cessation" if the ice-sheet was so thin and meager as Mr. Lesley imagines? The hyper-cataclysmal language here used for one series of phenomena, the result of a melting of an ice-sheet which was merely thick enough to "polish off" the topography of a continent, appears somewhat illogical and extreme. Should it not apply to the ice-mass as well? Farther on, to account for "vast heaps of rounded boulders" and other drift deposits on the tops of crests, ridges and hills at elevations of near 1000 feet in the counties above named, the director of the survey remarks: "It seems to me necessary to suppose some sort of submergence of the region beneath sea-level, or, what will amount to the same thing, a general rise of ocean-level to 800' or 1000', A. T. This would flood all Southeastern Pennsylvania to within a few hundred feet of the crests of its mountains, and account for most of the terrace deposits in this region."

While Northeastern New England has evidently been submerged some 500 feet, as marine fossils clearly indicate, are there any facts which show that this submergence extended much, if any, below New York city? We have supposed that south of this point the oscillation of the coast line was confined to but a few feet, as witnessed by the position near sea-level of the Quaternary beds of South Carolina.

The continued survey of the surface geology of a region like Pennsylvania, which lies both south and north of the great terminal moraine, will, in the end, aid much in solving such questions as have been brought up in the present able report.

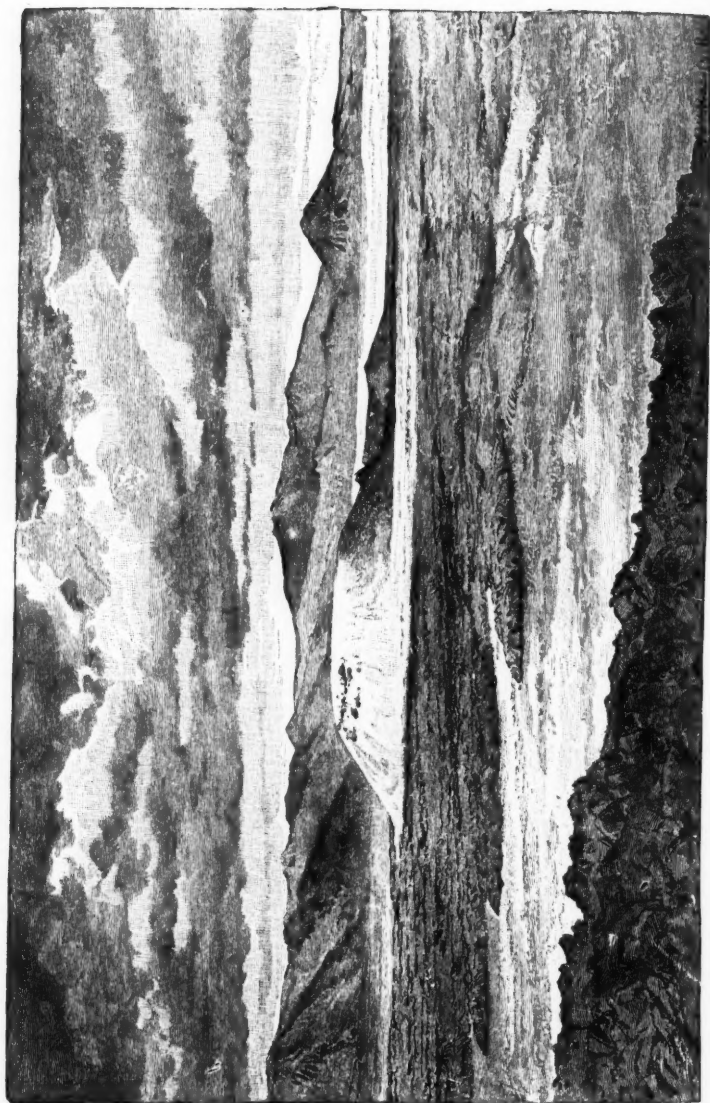
SECOND REPORT OF THE U. S. GEOLOGICAL SURVEY.<sup>1</sup>—Though this report has been issued for some time it has not been noticed in this magazine. It is a bulky royal octavo volume, well printed on good paper, with excellent and abundant illustrations (sixty-one plates and thirty-two wood-cuts); the mechanical execution being much superior to the average Government report. The more notable contents are the reports on the physical geology of the Grand Cañon district by Capt. C. E. Dutton; Contributions to the history of Lake Bonneville, by G. K. Gilbert; abstract of a report on the geology and mining industry of Leadville, by S. F. Emmons; a summary of the geology of the Comstock lode and the Washoe district, by Geo. F. Becker; production of the precious metals in the United States, by Clarence King; a new method of measuring heights by means of the barometer, by G. K. Gilbert.

The splendid report of Captain Dutton on the Grand Cañon district having been published in full, we shall defer our notice of

<sup>1</sup> *Second Annual Report of the United States Geological Survey to the Secretary of the Interior, 1880-81.* By J. W. POWELL, director. Washington, 1882. Royal 8vo, pp. 588.



PLATE XV.



Tabernacle Crater and lava beds.

it to another occasion, and meanwhile draw attention to Mr. Gilbert's elaborate essay on Lake Bonneville, a subject which he has studied for a number of years past.

The sediments of this ancient Quaternary lake rest upon Pliocene rocks, which are hard enough to be used as building stone, and in many places have been upturned, faulted, while portions, separated from their continuations in the valley, have been carried high up on mountain flanks, where they have been eroded into typical mountain forms.

From his study of the lake sediments and ancient beaches, Mr. Gilbert suggests the following history of the lake:

1. A long period of dry climate and low water, during which the mountains of the desert were buried and the alluvial slopes of marginal mountains were formed (Pl. xiii).

2. A period of moist climate and high water, during which the yellow clay was deposited and the shore was carried within ninety feet of the summit of the lowest barriers of the basin.

3. A period of extreme dryness, during which the lake disappeared and its salt was buried.

4. A relatively short moist period, during which the white marl was thrown down, and within which the water overran the barrier, diminishing by erosion its height at the point of discharge.

5. The present period of relative dryness.

The volcanic rocks of the lake valley are basalts; of these Pavant Butte (Pl. xiv), situated between Fillmore and Deseret, is the most conspicuous. It is entirely composed of tuff. Midway between its base and its summit it is encircled by a terrace formed at the highest stage of the lake. The mountain was a sublacustrine volcano; its cone having been completed during the highest stage of the lake.

On the other hand another volcano, the Tabernacle (Pl. xv), has no "benches" or shore lines, and no lake beds resting upon it. The volcano began to be formed there during a high stage of the lake, and was continued or renewed after the water had fallen below the level of the vent; while facts show that the date of the last eruption from the vent was just before the final subsidence of the water. The period of volcanic activity has lasted, then, through the entire history of the lake, and perhaps the end has not yet been reached. "No one," says Mr. Gilbert, "who has seen the fresh, black, unworn surfaces of the most recent *coulees*, still absolutely barren of vegetation, could be affected by surprise if it should some day be announced that the now quiescent fires had again broken forth."

It appears that there is a difference in the height of the Bonneville and Provo shore lines, neither of the two shore lines being now horizontal or parallel; hence it is inferred that there have been orographic movements both during the existence of the last

high stage of the water and since the final subsidence; and it seems that the region of the eastern margin of Lake Bonneville has recently fallen and is still subsiding. Mr. Gilbert has also found that a recent fault has taken place along the Wasatch range, not yet completed in the rear of Salt Lake city, and that the Wasatch range, the greatest mountain mass of Utah, has recently increased in height, and is supposed to be still growing.

The remains of Lake Bonneville is now but a great shallow brine pool, and resting on the surface of a broad plain. "Its mean depth is scarcely fifteen feet, and only a slight oscillatory movement of the plain would be necessary to decant its waters into another portion." It thus appears that the Mormons are exposed to the liability not only of losing their lake, but also their chief city!

HOPLEY'S SNAKES, CURIOSITIES AND WONDERS OF SERPENT LIFE.<sup>1</sup>—This pleasantly written book ought certainly to cure some of its many readers of their inherited hatred of snakes. The introduction brings out amusingly the confusion of names and natures which prevails among humanity, and the publisher's dread that he should lose subscribers if he put snakes in his magazine is but a mild manifestation of the ordinary horror of these creatures.

Thoroughly aware that the majority of even those people who have read of the peculiar structure of the skeleton, and especially of the jaws of a snake, do not realize the manner in which these peculiarities, correlated as they are with important departures from the ordinary reptilian type in the soft parts of the body, modify the habits and actions of snakes, Miss Hopley is careful to describe from the life how snakes feed; what the tongue is and is for; how snakes breathe and hiss; how they climb and constrict their prey; and how their teeth and fangs are constructed and arranged.

The author avers that a few years ago she knew nothing about snakes, and it is this fact, joined with sound judgment and correct observation, that has enabled her to write a book that speaks to those who do not know. When she discusses such questions as "Do snakes drink?" "Do they incubate their eggs?" and "Do they afford a refuge to their young?" she not only critically examines the opinions of others, but adds observations of her own that seem convincing. For example, the yellow Jamaica boa's method of imbibition, is thus described: "The snake kept its mouth just below the level of the water, and the only action or movement seen was at the back of the head, or on each side of the neck, like a pulsation, as the water passed down in short gulps. This is the 'suction' which writers describe, a drawing in of the liquid; but the lips do not take part in the act. When,

<sup>1</sup> *Snakes, Curiosities and Wonders of Serpent Life.*—By Catherine C. Hopley. Griffith & Farran, St. Paul's Churchyard, London, and E. P. Dutton & Co., New York, 1882.

therefore, we read that snakes drink both by lapping and by suction, we may surmise that the former is for the benefit of the tongue." The incubation of *Python sebae* is described, and the viviparity or oviparity of snakes generally, is clearly shown to depend simply upon the longer or shorter retention of the eggs within the body of the mother, and to vary in the same species. That some species afford a refuge for their young, is regarded as proved, and the author believes that this occurs in viviparous snakes, or in those in "which from some cause or other extrusion has been so postponed that the young are conscious of existence before birth." The habit is referred to a knowledge on the part of the young of the locality which formerly afforded protection, and remembrance on the part of the mother of previous protection afforded. The protrusion of the glottis during the act of swallowing, so as to enable the snake to breathe while the entire space between its jaws is occupied by living prey, is another little-known point in the economy of snake-life that is rendered clear in these charming pages.

Fascination is explained as of varied origin, in some cases curiosity, in others fear, in still others maternal anxiety for the fate of the young. The swiftly darting tongue is spoken of as a successful lure for birds, which appear to mistake it for a worm or insect. Cures for snake bites are discussed, and it is shown that though many powerful stimulants are successful as remedies, no real antidote for snake-poison is yet known. The illustrations, though few, are well chosen, and most of them original, showing attitudes assumed by snakes under various conditions.

The general reader will find the book a fascinating one, while the more scientific student will rise from its perusal with the consciousness that, though he might have previously known a great deal about snake anatomy, he has learned something new about snakes themselves.

BULLETIN OF THE BUFFALO SOCIETY OF NATURAL SCIENCES.—The final number of the fourth volume of the organ of this active society has just been received. It is a brochure of nearly 140 pages, and is devoted to an enumeration of the cryptogamic plants of Buffalo and its vicinity, in continuation of the catalogue of phænogamous plants, by David F. Day, forming Part III of the same volume. The first two numbers contain entomological, palæontological and ornithological papers of value.

THE STANDARD NATURAL HISTORY.—Nos. 7 to 10 of this valuable publication have reached us. In No. 8 the account of the stalk-eyed Crustacea, prepared by Mr. J. S. Kingsley, is finished; then succeeds the sessile-eyed Crustacea; the groups of Arthropoda of doubtful position, including the Pycnogonida, the Trilobites and Merostomata, as well as the Pentastomida, all prepared by Mr. Kingsley, who then offers an introduction to Class II, Insecta, the part closing with the commencement of an account

of the first sub-class, Malacopoda (Peripatus). This, like the other parts, is illustrated with well-printed wood-cuts.



The Prairie Dog at Home.

In Part 7 Dr. Coues completes the Rodentia. This order is succeeded by Dr. Gill's account of the Insectivora and Chiroptera. The work is both modern and popular in its treatment, and cannot fail to adequately fill a hitherto empty niche in the naturalist's library.

#### RECENT BOOKS AND PAMPHLETS.

*Hayden, F. V.*—General geologic map of the area explored by Dr. F. V. Hayden and the surveys under his charge, 1869 to 1880. From the author.

*Provancher, L.*—Petit Faune Entomologique du Canada et particulièrement de la province de Quebec, Vol II. Les Orthoptères, les Néuroptères, et les Hyménoptères. Quebec, 1883. From the author.

- Anonymous*.—Clavis Rerum. 1883. Norwich, F. A. Robinson & Co. From the publishers.
- Müller, H.*—The fertilization of flowers. Translated and edited by D'Arcy W. Thompson, B.A. Macmillan & Co. London, 1883. From the publishers.
- Taylor, T.*—Naphthaline as an insecticide. Read at the 54th meeting of the Biological Society of Washington, Dec. 28, 1883. From the author.
- The Photographic Times, Feb., 1884. From the editor.
- Peckham, G. W. and E. G.*—Descriptions of new or little known spiders of the family Attidæ, from various parts of the United States of North America. 1883. From the authors.
- Johnson, S. W.*—Annual report of the Connecticut Agricultural Experiment Station. 1883. From the director.
- Graff, G. G.*—The Book of Plant Descriptions, or record of plant analyses. For the use of teachers and students. Science and Health Publishing Co., Lewisburg, Va. 1883. From the publishers.
- Bureau of Education. Report of the Commissioner of Education for the year 1881. From the department.
- Traquair, R. H.*—On a new fossil shark (*Ctenacanthus costellatus*). Ext. from the Geol. Mag., Jan., 1884.
- Notes on the genus *Gyracanthus* Ag. Ext. from Annals and Mag. Nat. Hist., 1884. Both from the author.
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- Nachträge zu den Funden in den Phosphatlagern von Helmstedt, Buddenstedt u. a. 1883. Both from the author.
- Wilson, E. B.*—The mesenteric filaments of the Alcyonaria. Abh. aus der Mittheil. Zool. Stat. zu Neapel. From the author.
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- Wortman, J. L.*—Fossil horses, from W. H. Clarke's work on Horses' Teeth. Revised edition, 1883. From the author.
- Hunt, T. S.*—The geological history of serpentine, including studies of pre-Cambrian rocks. From the Trans. Roy. Soc. of Canada. Montreal, 1883. From the author.
- Lyman, Benj. S.*—Geological and topographical maps of the oil sands of Japan. 1882. From the author.
- Geological and topographical maps of the Hinckley and New York and Westmoreland coal tracts. 1883. From the author.
- Garrett, P. C.*—Progress of industrial education. Read at a meeting of the Phila. Social Science Assoc., Dec. 6, 1883. From the author.
- Putnam, F. W.*—Account of recent geological excursions in Wisconsin and Ohio. Read at meeting Amer. Antiq. Soc., Oct. 22, 1883. From the author.
- Smith, E. A.*—Geological survey of Alabama. Agricultural features of the State. 1883. From the author.
- Gardner, J. S.*—On the Gault Aporrhaidæ. Ext. Geol. Mag., April, 1875.
- On the Gault Aporrhaidæ. Idem, May, 1875.
- On the Gault Aporrhaidæ. Id., July, 1875.
- On Cretaceous Aporrhaidæ. Id., Sept., 1875.
- On Cretaceous Gastropoda. Id., April, 1876.
- On Cretaceous Gastropoda. Id., Dec., 1877.
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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.<sup>1</sup>

AFRICA.—*The Ancient Gulf of Triton.*—Dr. Rouire (*Rev. de Geog.*, Janv., 1884) believes that he has satisfactorily identified the Gulf of Triton mentioned by Herodotus and other writers with Lake Kelbiah, and the country between it and the sea. The Chotts of the Tunisian Sahara can scarcely have been this gulf, since the bar of Gabes, which divides them from the sea, is not alluvial, but is composed of older geological beds, rising more than 130 feet above sea-level. Moreover, remains of prehistoric dwellings have been found upon this bar. To the north of Gabes, between Enchir Béniana and Erghela, is a veritable sand bar some four miles long, separating the "Sebka" Djérîba from the sea. Further back rises the elevation of Djémiah, and on each side of this passes a branch of the dry Oued Menfes, leading into Lake Kelbiah, a sheet of water about thirteen miles long. Beyond this lake is the valley of Kroussiah, bounded by an abrupt cliff some 200 feet high, presenting indubitable signs of having been an ancient coast line. In rainy seasons the waters of the Oued Bagla pour into Lake Kelbiah, which rises until the valley of Kroussiah is inundated, and the waters fill the dry channels of the Oued Menfes, and communicate with the sea.

<sup>1</sup>This department is edited by W. N. LOCKINGTON, Philadelphia.

For awhile the Gulf of Triton is formed as described by Herodotus. At the mouth of the gulf is the Island of Phla, equivalent to the temporary Island of Djémiah, between the branches of the Oued Menfes, and further inland the waters of the lake bathe the shores which, before the narrow sand bar was thrown up, were permanently washed by the sea. The Little Syrtes of Scylax is thus identified with the Gulf of Hammamet, Hadrumetum with Sousa, Leptis Parva with Lemta, and Neapolis with Nabel-Kedimi. Communication between the Sahel and the interior of Tunis is even now difficult and dangerous during much of the year, for, except to the south, towards Sfax and Gabes, the bed of the ancient sea, still marshy and apt to be flooded, must be crossed. These identifications necessitate a new interpretation of many historical passages referring to the history of Carthage.

*The Wolofs and the Kingdom of Cayor.*—The Wolofs were formerly united into one kingdom, but now form three. Of these Cayor extends southward from St. Louis to a little beyond Cape Verd. It has no river, but a chain of fresh-water lakes or marshes a few kilometers from the ocean gives rise to a luxuriant vegetation; and the rest of the country, watered by abundant rains from July to October, yields an abundance of fruit and vegetables, though water can only be obtained from wells. Contact with the French and the Moors has made Christians of some Wolofs and Islamites of others, but Gen. Faïdherbe (Bull. de la Soc. de Geog., 1883) confesses that the former are more drunken, and the latter more false, than their heathen brethren.

ASIA.—*Kafiristan.*—Mr. McNair, who penetrated Kafiristan in disguise, to escape the opposition of the surrounding Mohammedans, has recently given to the Royal Geographical Society an account of his visit.

Kafiristan contains 5000 square miles, is bounded on the north by the Hindu Kush, on the south by the Kunar, and on the west by the Alishang and its tributary, the Alingar. On the east its boundary is not clearly defined, but may be roughly said to run from the Dara pass to the source of the Kalashgum, down that river to its junction with the Kunar, and down the latter to its union with the Kabul. There is also an isolated tract north-west of the Dara pass. The three main tribes are the Ramgals, Vaigals and Bashgals, each occupying one of the large valleys. Each tribe has a district of its own, and, as a rule, has little to do with the other valleys. The Vaigals are reckoned to be most powerful. Three of the five tribes of the Bashgal pay a nominal tribute to the Mohammedan ruler of Chitral, but the other two are quite independent. The entire population is estimated at 200,000 souls. The men have sharp Aryan features and keen, penetrating eyes, usually brown, but occasionally blue. Brown eyes and light, even golden hair often occur in combination. The complexion

varies from extreme fairness, almost pink, to a bronze, as dark as that of a Pathan. The cast of features seems the same in both, but the fairer men will say that they came from the north, and their darker brothers from the south. They are short of stature, daring, but lazy, leaving the agricultural work to the women, and spending their own time in hunting. They are passionately fond of dancing, in which both sexes join in the evening round a blazing fire. The houses are generally built on the slopes of the hills; the lower story is of stone, from twelve to fifteen feet high, and is used for storage of wood and of the ordure of cattle, which is used for fuel. The upper story, or house proper, is built of wood, and contains only one or two rooms, which are neat, but very dark. The door and door-frames are roughly carved with figures and scrolls, and there is but little furniture. They all sit on wooden chairs or wicker stools. Their bread is ordinarily a very thick cake, but thin, broad cakes are made when guests are entertained. Meal, boiled in a large iron caldron, is served in deep, circular wooden vessels, hollowed from a tree. Tables seem to be used only to place drinking-vessels upon. The cheese is of the nature of cream-cheese, is made daily, and is given to guests between two cakes, embedded in hot butter. Their beds are rude fixtures of poles, one end of which rests in the walls, the other on two legs. This story is reached by a ladder, which can be drawn up. Sometimes there is a third story, also of timber. A platform surrounds the upper stories. The roof is of flat stones laid on beams and covered with mud.

The temples are square chambers of timber, with carved and colored doorways; inside are several stones, apparently boulders from the river bed, but no images were seen, except those connected with funeral rites. The temples seem to be chiefly used in connection with these rites. The coffins are carried there and sacrifice performed before burial. The men shave the whole of the head, save a patch on the crown; and usually wear Indian cotton clothes; the women wear a single garment, something like a loose morning gown, and the hair is worn plaited and covered over with a broad cap with lappets. Just over the crown stick up two tufts, which look like horns. Slavery exists to a certain extent. Polygamy is the exception; a mild corporal punishment is inflicted on unfaithful wives, and a fine of cattle-heads is exacted from the male offender. The dead are not buried, but placed in coffins in a sort of cemetery, often on a hill-side. Carved wooden figures are placed at the heads of the coffins of persons of rank and note of either sex. One Supreme Being (*Imbra*) is universally acknowledged. They drink much wine, pure, unfermented grape-juice. Their arms are bows, arrows, and daggers. A few matchlocks have found their way into the country, but they make none.

The country is picturesque, densely wooded, and wild in the

extreme. Mr. McNair is the first Englishman who has penetrated into Kafiristan, and even he, owing to the penetration of his disguise through the treachery of a supposed friend of the British government, did not go beyond the outskirts.

The Swat valley, reached by the Malakand pass (3575 feet), has a very rich soil, but is unhealthy. In it are many Buddhist topes, some quite as large as the famous tope of Muni Kiyala. There are also many excavated caves. Colonel Yule (in the discussion which followed Mr. McNair's narrative) stated that this valley, the natives of which had become Afghanized, was eighteen to twenty centuries ago one of the most sacred spots of Buddhism. At Dir Mr. McNair received a seal, which proved to be of Babylonian workmanship.

The Kafirs are ever at war with their Mohammedan neighbors, and are said to pray: "Ward off fever from us. Increase our stores. Kill the Mussulmans. After death admit us to Paradise." Yet many have been, during the course of ages, converted to Islamism. Sir H. Rawlinson said that there was no foundation for the belief that these Kafirs or infidels, as the Pathans called them, were descended from Alexander's soldiers. Their languages are of the Perso-Indian branch of the Aryan family.

The pass leading from Swat valley is 7310 feet above the sea; the fort of Dir 5650 feet; the Lowara Kotal pass, leading to the valley of the Kunar, 10,450 feet; and Chitral, at the head of the Shushai valley, 5151 feet. The dorsal ridge of the Hindu Kush has here a mean elevation of about 16,000 feet, while the Tirach Tir mountain is 25,426 feet high.

#### GEOLOGY AND PALÆONTOLOGY.

T. S. HUNT ON CAMBRIAN ROCKS OF NORTH AMERICA.<sup>1</sup>—The writer gave his reasons for limiting the term Cambrian to the Lower and Middle Cambrian of Sedgwick, which contain the first fauna of Barrande. For the Upper Cambrian or Bala group holding the second fauna, wrongly claimed by some as a lower member of the Silurian, and by others called Cambro-Silurian, he prefers the term Ordovician, now accepted by many British and continental geologists. This includes in New York the Chazy, Trenton, Utica and Loraine divisions, the Oneida marking the true Silurian or third fauna. The Cambrian rocks of the great North American basin may be studied in four typical areas: 1. The Appalachian; 2. The Adirondack; 3. The Mississippi; 4. The Cordillera area. To the first of these belongs the immense volume of greatly disturbed sediments along the whole eastern border of the basin, constituting the First graywacke and the Sparry limerock of Eaton, being the Upper Taconic of Emons, and the Potsdam group and Quebec group of Logan.

<sup>1</sup> Abstract. Read before Boston Soc. Nat. History, Feb. 20, 1884.

They are distinct from the unconformably underlying Taconian quartzites, marbles and schists (Lower Taconic) which the author regards as Precambrian, and the still older crystalline schists of the Atlantic belt, including those, chiefly of Huronian age, which have been called "Altered Quebec group." The name of Taconic cannot be retained for the Appalachian Cambrian, which was, as early as 1861, correctly claimed by Emmons as belonging to the period of the first fauna. The Hudson River group, as originally defined, included the whole of the Appalachian Cambrian, with some portions of the underlying Taconian, and others of overlying Ordovician strata, from which in the Appalachian area their characteristic limestones are wholly or in great part absent. It is from solely this association with the Cambrian graywacke of strata of Loraine age that the Hudson River group has come to be regarded as the palæontological equivalent of the Loraine.

In the stable and little disturbed area around the Adirondack mountains, including the Champlain and Ottawa basins, the Cambrian is represented only by the quartzites and magnesian limestones of the Potsdam and Calciferous divisions, which are shallow-water deposits, corresponding apparently to small portions only of Cambrian time. The physical conditions of the Mississippi area appear to have been similar to that of the Adirondack region. As seen to the west of Lake Superior the lowest Potsdam beds of Hall rest unconformably upon the great Keweenaw or copper-bearing series. This, although containing, as the speaker had elsewhere shown, some evidence of organic life, probably worm-burrows and sponges, cannot be claimed for the Cambrian till it shall have been shown to contain a Cambrian fauna. In this north-western area we find, moreover, beneath the Cambrian horizon, representatives of the Laurentian and of the Norian. The latter in the typical norites or so-called gabbros, which, near Duluth, are directly overlaid by the Keweenaw, elsewhere resting on Laurentian or on Huronian rocks. There also are found in Wisconsin petrosilex rocks of Arvonian type, with quartzites, rising from beneath the Cambrian sandstones. Typical Montalban and Huronian rocks also occur around this area, besides the group which the speaker long since called Animikie. This great series, of many thousand feet, which is overlaid unconformably by the Cambrian sandstones, and also, according to Irving, by the Keweenaw, consists chiefly of quartzites and argillites with beds of magnetite. The remains of a sponge have been detected in a calcareous mass got by the speaker at Thompson, Minn., from the argillites of this series, which, in a late communication to the National Academy of Science, he has referred to the Lower Taconic or Taconian horizon. He now stated his conclusion, drawn from various facts, that while these Animikie rocks rest unconformably in this region upon the Huronian, the two series have hitherto been confounded under the common name of Huronian.

As regards the Cambrian of the fourth area, that of the Cordilleras, the speaker alluded to the important observations of Powell and the recent studies of Walcott. Great local variations may here be looked for, and discoveries which will enable us to understand better the relations between the Appalachian Cambrian and the other areas mentioned, as well as those on the Atlantic coast in Massachusetts, New Brunswick and Newfoundland.

THE GEOLOGY OF ALGIERS—FORMATIONS BELOW THE TERTIARY.—In a recent issue of the *Annales des Sciences Geologiques*, M. A. Peron describes, with great thoroughness, the geology of Algiers. The great geographical feature consists of two parallel chains of mountains, bearing from W.  $17^{\circ}$  N. to E.  $17^{\circ}$  S. These mountains were uplifted in the Quaternary age, so that, as in the Alps, the Tertiary strata have been disturbed, and contribute to the formation of the mountains. Between these two parallel ranges lie an elevated zone of plateaus, which was uplifted at the same time. To the south of the southern crest extends an immense region through which the strata lie horizontally. This is the Algerian Sahara. Beyond this, on the confines of the Soudan, traces of dislocation appear, with eruptive rocks, and some vegetation. The different geological strata are disposed in long belts parallel to the coast, and the same arrangement obtains in Tunis and Morocco. The country is thus divided into zones, bearing each its distinct soil and climate, productions and people. The principal axis of the Algerian chain is that of the north, and it is this which has determined the direction of the Mediterranean coast. Previous to the uplift of the mountains, repeated and considerable outflows of igneous rocks had taken place, but the greatest outflow occurred in the Quaternary epoch. A great part of the effects of this plutonic outburst are hidden beneath the sea, but the northern coast of Sicily to the east, and Madeira to the west, are in the line of the basalts of the African coast. The rivers which flow northward and southward all have their origin in the plateau region between the two chains of mountains, and no visible crest separates streams running in opposite directions. Every one of these streams has to pass across the mountains, and hence results the multitude of gorges by which these chains are intersected. The oldest strata are crystalline schists, granite gneiss, mica schist, etc. These occur upon the coast, and form mountain masses or islands. Palæozoic strata are not extensive, but are most developed in the province of Oran. Some schists, with vegetable impressions, graphitic schists, etc., are referred to the Silurian, and the pudding-stones and conglomerates with polyyps, encrinites and foraminifera of the environs of Ain-Talba, are referred to the Carboniferous by M. Bleicher. The Devonian does not seem to be represented in Algiers, though it undoubtedly occurs in Fezzan. No traces of the Permian have yet been found, and the identification of certain

beds with the Triassic rests solely upon their position below the Jurassic, and has no palæontological proof. Most of the horizons of the Jurassic are represented, but organic remains are rare, and the strata are sometimes metamorphic. The oldest Jurassic strata exist in the mountain region, and are marked by characteristic species. The Upper Jurassic (*corallien*) appears to form a long band running from east north-east to south-south-west across the high plateaus. The Neocomian, or Lower Cretaceous, is met with in the Tell, or mountain region, in the high plateaus, and as far as the confines of the Sahara, yet does not occupy large areas. The Urgo-Aptien (as our authority styles the strata between the Neocomian and the Gault), occupies large areas in the south of the country. The Gault (*Albien*) acquires in Algiers a thickness of 150 to 300 meters, and is in great part composed of rocks deposited mechanically. It presents distinct characters in different parts, and is tolerably rich in fossils. The Cenomanian is one of the most important and widely spread formations of Algiers, reaches a thickness of 500 meters, and enters into the formation of almost all the mountain masses, except those of the coast. Wherever this formation extends the surface of the country is particularly uneven, full of ravines and peaks, or rocky crests of difficult ascent, and almost completely sterile. These strata are as poor mineralogically as agriculturally, but fortunately they are extremely rich in fossils. Though the Cenomanian occurs in the north, its greatest development is in the parallel chains which separate the long depression of the chotts from the Sahara.

The Turonian is also extensive. It is composed of a considerable mass of limestone with *Rudistes*, and of some other beds between this and the Cenomanian. It occurs in the Tell, or northern mountain region, in the high plateaus, and in the Sahara. The Senonian, or Upper Chalk, is utterly unlike the parallel stage in France. It is composed of marls and limestones, usually almost black, and the fossils consist to a large extent of gastropods and lamellibranchs, especially oysters, and echini. In the 400 meters of this stage neither sandstone, sand, dolomite, flint, nor chalk are met with. The whole appears to have been deposited in a deep and quiet muddy sea, under similar conditions, for the facies of the fossils is pretty much the same throughout the various beds, and though individuals are plentiful, specific types are few. Polyps, sponges, polyzoa and brachiopods are entirely absent. *Rudista* are very rare, and cephalopoda represented by but few species, principally of *Ceratites*.

THE SKULL OF A STILL LIVING SHARK OF THE COAL MEASURES.—The genus *Didymodus* is a well-known form of *Elastomobranchi* of the Coal Measures, and I have reported it as occurring also in the Permian. Mr. S. Garman has recently published an account of a shark supposed to have been taken off the coast

of Japan, which he names *Chlamydoselachus anguineus*,<sup>1</sup> referring it to a new genus and family. He figures the teeth, and these are, as I have pointed out,<sup>2</sup> identical with those of the genus above-named.<sup>3</sup> The species should then be called *Didymodus anguineus*.

Crania of species of *Didymodus* are not uncommon in the Permian formation, and a description of the character of this part of the skeleton forms the subject of a paper recently read by the writer before the American Philosophical Society of Philadelphia.

The palatopterygoid arch is suspended to the postorbital process of the cranium as in the existing Hexanchidæ. The genus would then be referred to the sub-order Opistharthri of Gill, but for the following peculiarities: The skull is segmented, so that cartilage-frontals, parietals and occipitals can be distinguished, together with an element which has the position of the intercalare. The occipital supports a large vertebral cotylus. There are membrane bones extending from the nose over the orbits, which are either supraorbitals or frontals. The tissue of the bones is granular, which leads to the belief that the granular ossification which covers the chondrocranium in recent sharks, penetrated the entire chondrocranium in this genus. Hence the basicranial axis consists of the sphenoid and presphenoid bones. One at least of the nares is on the superior face of the muzzle. The frontal cartilage-bones are elevated and fissured at the posterior extremity, each apex projecting freely upwards and backwards, presenting a certain resemblance to the structure seen in the *Lepidosirenidæ*.

The structure points to the type from which the true fishes (*Hypomata*) diverged from the sharks. The characters are thought to define an order of the sub-class Elasmobranchii, equivalent to all the other known forms. To these two divisions were given the names of *Ichthyotomi* and *Selachii*.—*E. D. Cope*.

LESQUEREUX ON CRETACEOUS AND TERTIARY PLANTS.—The eighth volume of the final reports of the U. S. Geological and Geographical Survey of the Territories on the Cretaceous and Tertiary flora of the Western Territories, by Leo Lesquereux, has been in type at the Public Printing-office in Washington for over six months past, and will be issued soon. That it will prove to be a very important contribution to the vegetable palæontology of the United States the following brief synopsis will show:

Besides the description of species, the text gives general remarks on the geology of the Dakota group, on the characters of the plants in regard to climate, and their affinities with forms of succeeding geological periods. A table of distribution, enumerat-

<sup>1</sup> Bulletin of the Essex Institute, VOL. XVI.

<sup>2</sup> *Science*, March 7, 1884, p. 274.

<sup>3</sup> *Didymodus Cope*. Proceedings Academy Philadelphia, 1883, p. 108. *Diplo-*  
*lus Agass.*, name preoccupied in recent fishes.

ing all the species known until the present time, of the flora of the Cenomanian in Europe, North America and Greenland, points out the relation with the plants of different localities. Atawe for Greenland; Moletin Inedlinberg, Needersham, the Quader sandstone, &c., for Germany; and the Dakota group, with species obtained in Nebraska and Kansas, and those found also in Colorado at the base of the Rocky mountains. The above refers to the first part of the report, the Cretaceous flora, with seventeen plates.

The second part comprises a revision of the plants of the Laramie group: 1st. Introduction, considering the relations of these plants with those of Europe, to establish the age of the formation. 2d. Descriptions of a few new and well-marked species from very fine specimens, with three plates. 3d. A table of distribution, including only the species of the Laramie group, which in the seventh volume were mingled with those of the other stages of the Tertiary, and were not grouped distinctly enough for the appreciation of the general characters of the flora.

The third part comprises the flora of the Green River group. The characters of the plants separate the formation into the divisions. The plants of the Green River and Alkali stations, and Randolph county, being different, most of them, from those of Florissant, mouth of White river and Elko. The description of the species are illustrated by twenty-one plates, and the relation of the flora with that of the Gypsies of Aix, in France, which is considered as lowest Miocene or Oligocene, is indicated. The table of distribution of these plants includes for America those of Florissant, Elko, Green River station, Alkali station, Sage creek, Barrell's springs, in relation with the Miocene of Greenland, Alaska, the Oligocene of France and Germany, and the Miocene of Europe. The table is followed by general remarks and conclusions derived from the comparisons.

The fourth part relates to Miocene plants described from specimens received from the Bad Lands, California, Oregon, and Alaska; three (3) different groups considered separately. The illustrations fill fifteen plates, and one plate for a few species from a more recent Tertiary formation of California, probably Pliocene. The table of distribution indicates the relation of the species of Alaska, Carbon, Washakie, the Bad Lands, Oregon, California, Fort Union group, with the Arctic Miocene, Greenland, Spitzbergen and that of Europe.

This eighth volume is a complement of the two preceding, the sixth and seventh. It describes, figures or enumerates all the plants which have been found up to the present time in the formations of Mesozoic and Cenozoic epochs of North America, and, therefore, contains most valuable materials in vegetable palæontology for the direction of future researches, and the classification and determination of the fossil flora of the continent.—*F. V. Hayden.*

GEOLOGICAL NOTES.—*General*.—The *Revue Scientifique* (Jan. 19) contains a geological map and description of Borneo, according to the recent explorations of Dr. T. P. Tivadar. Situated in the midst of a volcanic region, this great island contains no active volcano. The five central mountain chains, which radiate from a common center and attain some 4000 meters in height, consist of amphibole-gneiss, mica-schist, and talc-schist, with intercalations of peridotite and serpentine, very strongly folded. The cincture of undulating hills around these mountains is arenaceous, and is believed to be eocene, and the vast plains between these hills and the sea consist of ancient and modern alluvium. Some arenaceous clays, impregnated with salt, serving as a substratum to the vast salt-marshes of the lower parts of the island, seem older than the eocene hills, and may be of secondary age.—The Alps of New Zealand, according to Mr. Green, were probably uplifted in Jurassic times. The oldest rocks—granites (or possibly in part granitoid gneisses) appear on the western side; these are overlain by crystalline schists, to which succeed slates, grits, etc., of Silurian and later ages. The highest rock on Mount Cook (12,349 feet) appears to be a quartzite, and Mr. Green mentions the occurrence of some volcanic tuffs lower down the mountain.—Mr. E. T. Hardman has obtained the data for a geological sketch-map of 12,800 square miles in the Kimberley district of Western Australia. The lowest rocks are quartzites, schists and other metamorphic rocks, which he provisionally classes as Lower Silurian, but which may be Archæan. These are succeeded by limestones and sandstones with gypsum, etc., supposed to be Upper Carboniferous. The newest deposits are Pliocene sands, gravels, conglomerates, and marley limestones (called "pindar" by the natives), overlaid by river gravels, extensive plains of alluvium, and, along the sea-coast, by raised beaches. Certain basalts and felstones of uncertain age also occur.—The report of the Geological Survey of Prussia, for 1882, contains twenty-two important papers, by members of the staff and others, with twenty-three plates of maps, sections and fossils.

*Cretaceous*.—M. Sintsoff has contributed to the Novorossian Society of Naturalists, at the University of Odessa, a monograph of the sponges from the chalk of Soratoff. He describes a number of new species and four new genera. The same author has also a paper on Mesozoic fossils from Simbirsk and Saratoff in which he describes two species of Ammonites, *Aporrhais striatocarinata*, and several other mollusca.

*Tertiary*.—M. Sintsoff has described several tertiary mollusks of Novorossia, including species of *Dreissena*, *Hydrobia*, *Neritina*, *Valvata*, *Trochus*, *Amnicola*, and *Phasianella*.—M. Cotteau has determined twenty-one species of Echinidæ from the tertiary strata of St. Valois (Seine Inferieure). Eight of these

have been found at other localities, in the Lower Eocene. Among the most interesting of the peculiar forms the author mentions *Goniopygus pelasgiensis*, the last representative of a genus abundantly diffused in the various stages of the cretaceous; *Sismondia archiaci*, which d'Archiac had erroneously united with *Echinocyamus subcaudatus* of the tertiary of Antibes (Var), but which differs from that species in the constant position of its periproct and other characters; and *Gualtiera orbignyi*, a type remarkable for its ovoid, posteriorly truncated form, by the arrangement of its ambulacral areas, which are severed at two-thirds of their length by an internal fasciole, and above all, by the protuberances which surround the peristome, and are prolonged along the center of the posterior interambulacral area. For these strata echini predominate, and other fossils are represented only by a few mollusks.—Mr. Thomas has recently studied the terrestrial and lacustrine tertiary and quaternary beds of Algeria, and has established several horizons, well characterized by the numerous fossils contained in them. Mr. Thomas has found some new mollusks, but has given his attention principally to mammals and has enriched palæontology with many new species. Among these is a *Cynocephalus*, three species of antelope, and a hipparion, the bones of which were associated with those of the horse, instead of preceding it, as is the case in Europe. All these are from the Pliocene.

*Quaternary*.—In the quaternary of Algiers, Mr. Thomas has found numerous flint implements, and remains of various animals. These include a rhinoceros, which, to judge from a molar, is *R. tichorhinus*, *Bubalus antiquus*, the horns of which measured ten feet between the points; *Bos primigenius mauritanicus*, two antelopes, a sheep, a mouflon, a camel nearly related to the dromedary, and an ass (*Equus asinus atlanticus*), which, in its dentition, preserves some resemblance to Hippotherium.

#### MINERALOGY<sup>1</sup>.

AN INTERESTING MINERAL FROM CANADA.—The writer has given a preliminary notice of a very interesting mineral from Wakefield, Ontario, Canada. It occurs as white or grayish-white square crystals, sometimes an inch in breadth, and often glazed on the outside. They are nearly square prisms with truncated corners, the general appearance being that of a partly altered scapolite.

They are tetragonal, with  $O \wedge 2 = 129\frac{1}{2}^\circ$ . The angles, as pointed out to the author by Professor E. S. Dana, are closely similar to those of *sarcolite*, the following planes being identified: O, i-i, I, 2, 2-i, 2-2, 6-3, the last two hemihedral. The mineral

<sup>1</sup> Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

<sup>2</sup> Proceedings Mineralogical and Geol. Section, Acad. Nat. Sciences, Nov. 26, 1883.

appears to bear the same analogy to sarcolite that gehlenite does to meionite. The crystals are distinguished by an almost entire absence of cleavage. Hardness 5-6, spec. gravity 3.050-3.057. Luster vitreous to resinous. The composition, as determined by Mr. R. Haines, is as follows, the enclosed calcite being subtracted from the analysis:

SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	CaO	MgO	K <sub>2</sub> O	Na <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	H <sub>2</sub> O
36.74	19.79	1.33	38.16	.77	.17	.32	2.49	.23 = 100

From this the quantivalent ratio of basis to silica is calculated as 0.6 or 2:3, thus explaining the

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CUBIC SPINEL.—Close to the locality where the above mineral was found, were cubes of a hard, dark mineral, the corners of which were truncated by small, brilliant, octahedral planes. The cubes were frequently an inch in diameter, and the cubic faces were striated and often curved, the edges also being convex. The polariscope showed that the mineral was isometric. Externally the crystals were nearly black, and were frequently covered with a film of iron oxide. Small fragments were transparent, and by transmitted light black or smoky sea-green or bluish-green color, rarely smoky amethystine. It scratched quartz, and as shown by

have been found at other localities, in the Lower Eocene. Among the most interesting of the peculiar forms the author mentions *Goniopygus pelasgiensis*, the last representative of a genus abundantly diffused in the various stages of the cretaceous; *Sismondia archiaci*, which d'Archiac had erroneously united with *Echinocyamus subcaudatus* of the tertiary of Antibes (Var), but which differs from that species in the constant position of its periproct and other characters; and *Gualtieria orbignyi*, a type remarkable for its ovoid, posteriorly truncated form, by the arrangement of its ambulacral areas, which are severed at two-thirds of their length by an internal fasciole, and above all, by the protuberances which surround the peristome, and are prolonged along the center of the posterior interambulacral area. For these strata echini predominate, and other fossils are represented only by a few mollusks.——Mr. Thomas has recently studied the terrestrial and lacustrine tertiary and quaternary beds of Algeria, and has established several horizons, well characterized by the numerous fossils contained in them. Mr. Thomas has found some new mollusks, but has given his attention principally to mammals and has enriched palæontology with many new species. Among these is a *Cynocephalus*, three species of antelope, and a hipparion, the bones of which were associated with those of the horse, instead of preceding it, as is the case in Europe. All these are from the Pliocene.

*Quaternary.*—In the quaternary of Algiers, Mr. Thomas has found numerous flint implements, and remains of various animals. These include a rhinoceros, which, to judge from a molar, is *R. tichorhinus*, *Bubalus antiquus*, the horns of which measured ten feet between the points; *Bos primigenius mauritanicus*, two antelopes, a sheep, a mouflon, a camel nearly related to the dromedary, and an ass (*Equus asinus atlanticus*), which, in its dentition, preserves some resemblance to *Hippotherium*.

#### MINERALOGY<sup>1</sup>.

AN INTERESTING MINERAL FROM CANADA.—The writer has given a preliminary notice of a very interesting mineral from Wakefield, Ontario, Canada. It occurs as white or grayish-white square crystals, sometimes an inch in breadth, and often glazed on the outside. They are nearly square prisms with truncated corners, the general appearance being that of a partly altered scapolite.

They are tetragonal, with  $O \wedge 2 = 129\frac{1}{2}^\circ$ . The angles, as pointed out to the author by Professor E. S. Dana, are closely similar to those of *sarcolite*, the following planes being identified: O, i-i, I. 2, 2-i, 2-2, 6-3, the last two hemihedral. The mineral

<sup>1</sup> Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

<sup>2</sup> Proceedings Mineralogical and Geol. Section, Acad. Nat. Sciences, Nov. 26, 1883.

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appears to bear the same analogy to sarcolite that gehlenite does to meionite. The crystals are distinguished by an almost entire absence of cleavage. Hardness 5-6, spec. gravity 3.050-3.057. Luster vitreous to resinous. The composition, as determined by Mr. R. Haines, is as follows, the enclosed calcite being subtracted from the analysis:

SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	CaO	MgO	K <sub>2</sub> O	Na <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	H <sub>2</sub> O
36.74	19.79	1.33	38.16	.77	.17	.32	2.49	.23 = 100

From this the quantivalent ratio of basis to silica is calculated as 9 : 6 or 3 : 2, thus placing the mineral among the subsilicates.

The mineral is insoluble or only partially soluble in acids, but gelatinizes with them after ignition.

Before the blowpipe it fuses at 3 with intumescence to a white glass. With the fluxes a slight reaction for iron is obtained.

A thin section examined under the microscope shows an admixture of calcite, which causes momentary effervescence when the mineral is placed in acid. The ground-mass is a gray amorphous, non-refracting substance resembling altered feldspar. Scattered through this are the unaltered crystalline fragments of a colorless, transparent tetragonal mineral, doubly refracting except in sections across the axis. The whole appearance resembles that of certain specimens of melilite, and shows alteration to have occurred throughout the whole of the crystals.

The microscopic characters are not those of a simple mineral. Dr. M. E. Wadsworth regards the colorless mineral (isotropic or tetragonal) as having replaced the gray amorphous substance, as though the latter had once occupied the entire space.

The crystals are imbedded in blue calcite, and are associated with pyroxene, graphite, cubical spinel (see below) and other minerals. They were given the author by Dr. A. E. Foote, who obtained them from the locality.

The species appears to be isomorphous with sarcolite, but its very different physical and chemical characters indicate either a distinct species or a pseudomorph. The absence of cleavage and the heterogeneous microscopic characters argue pseudomorphism. Chemically it is allied to gehlenite. The temporary name *caco-clasite*, referring to its imperfect cleavage, was suggested. The specimens are still under investigation.—*H. C. Lewis*.

**CUBIC SPINEL.**—Close to the locality where the above mineral was found, were cubes of a hard, dark mineral, the corners of which were truncated by small, brilliant, octahedral planes. The cubes were frequently an inch in diameter, and the cubic faces were striated and often curved, the edges also being convex. The polariscope showed that the mineral was isometric. Externally the crystals were nearly black, and were frequently covered with a film of iron oxide. Small fragments were transparent, and by transmitted light black or smoky sea-green or bluish-green color, rarely smoky amethystine. It scratched quartz, and as shown by

the following analysis, was evidently a true spinel of novel crystalline form:

SiO <sub>2</sub>	FeO	CaO	MgO	Al <sub>2</sub> O <sub>3</sub> (by difference)	
0.65	3.00	1.20	27.18	67.97	= 100

—H. C. Lewis.

THE ORIGIN OF THE DIAMOND.—W. H. Hudleston<sup>1</sup> has advanced an extraordinary theory to account for the origin of the diamonds of South Africa. As is well known, the diamonds occur in a sort of soft, earthy breccia, made up of fragments of many kinds of rocks, and evidently of comparatively recent origin. A great part of the enclosed pebbles consist of basalt and other igneous rocks. Pieces of coaly matter and fossil shells also occur in the diamantiferous breccia, the matrix of which is a soft hydrated ferro-magnesian silicate. Dykes of dolerite, gabbro and other intrusive rocks form the walls of the diamond-bearing formation. The author believes that it is certain that the whole of the matrix flowed upwards, and that "it is impossible to doubt the eruptive character of the diamond rock." He thinks that superheated steam was the eruptive agent, and suggests the analogy of mud volcanoes.

Since no diamonds have been found except in this soft breccia, he suggests that the diamonds were formed in the breccia itself, having been formed at a considerable depth and then carried upward with "the rise of the viscous fluid in the pipe." The carbon is supposed to have been derived from certain carbonaceous shales, which were distilled under enormous pressure, when the carbon would have "no choice but to assume the crystalline form."

Certainly this theory requires more evidence than has yet been presented to support it.

URANOTHORITE.—In 1876 Nordenskiöld found crystals of thorite at Arendal, Norway, having the form of zircon, and containing some ten per cent of protoxide of uranium. The same mineral was afterwards found by Lindström at Hitterö, Norway, and in 1880 an identical substance was found by Collier in the region of Lake Champlain, and called by him *uranothorite*, supposing it to be a distinct species.

Collier regarded the uranium as combined in the form U<sup>2</sup>O<sup>3</sup>, but as L. F. Nilson believes,<sup>2</sup> this was a mistake, the uranium existing as UO<sup>2</sup>. Now Zimmerman has proved that the uranium in the Norwegian thorite corresponds to UO<sup>2</sup>, and the thorium to ThO<sup>2</sup>, and that the two oxides replace one another in variable proportions. The mineral of Arendal is, therefore, but a variety rich in uranium of the thorite of Brevig, which was analyzed by Berzelius in 1829.

As the properties of the Lake Champlain mineral are identical with those of the Norwegian thorite, there is no reason for the name *uranothorite*.

<sup>1</sup> *Mineralogical Magazine*, Vol. v, No. 25, p. 199.

<sup>2</sup> *Ann. d. Chimie et Physique*, Nov. 1883, p. 429.

TOPAZ IN NEVADITE FROM COLORADO.—The "nevadite" of Chalk mountain, Colorado, is a porphyritic rock showing large glassy sanidine and many smoky quartz crystals imbedded in a grayish ground-mass, and is an eruptive rock, of probably early Tertiary age. Mr. W. Cross finds in certain druses very perfect crystals of colorless, transparent topaz. Although these crystals are very small ( $\frac{1}{2}$  to 3 millimeters in length), they are interesting on account of their occurrence in an eruptive rock, all previously known occurrences being in granite, gneiss or some other metamorphic rock. In the present case, as indicated by the associated minerals, the topaz may be a sublimation product.

TELLUR-SULPHUR.—There has long been recognized in Japan, as being distinct from ordinary sulphur, a full orange-red variety under the name of seki-rin-seki (massive red sulphur). This has been examined by E. Divers and T. Shimidzu,<sup>1</sup> who find that while it is allied to the selen-sulphur of the Lipari islands, Naples and Hawaii, it differs from it in composition, being a tellurium sulphur. Analysis yielded

Te	Se	As	Mo	S (by diff.)
0.17	0.06	0.01	trace	99.76

When the tellurium sulphur was treated with carbon bisulphide, the arsenic remained as sulphide. This red sulphur appears to occur at all the deposits of volcanic sulphur in Japan, having been found at a number of localities. It contrasts strikingly with the associated yellow sulphur. It would be of interest could the chemical state of the tellurium be determined. Meanwhile the mineral may be regarded as a variety of sulphur, and might be known as *tellur-sulphur*.

AMERICAN GEMS.—Some very beautiful tourmalines, of varying shades of color and of unusually perfect crystalline form, have been recently found at Auburn, Maine. The colors are pale shades of blue, green and pink, all these shades often present in the same crystal. Mr. W. E. Hidden describes their crystallographic form, which is of unusual interest. A number of other minerals occur at the same locality, which promises to be of financial importance regarding the production of material for gems.

A new locality for emeralds has been found in North Carolina, about a mile south-west of the locality now worked at Stacy point. The crystals are pale-green, and occur in decomposed black mica, associated with quartz, rutile and hiddenite. Mr. J. F. Kunz states that this new locality shows that the deposit of emeralds in North Carolina is not an accidental one, and that there is encouragement for future exploration for gems in that State.

MINERALOGICAL NOTES.—During the year 1883 *sixty millions of pounds of copper* were extracted from the Lake Superior mines. —*Ozokerite* has been found in the Island Tscheleken in the

<sup>1</sup> *Chem. News*, Dec. 21, 1883.

Caspian sea. It is a brownish-black, sticky mass, almost entirely soluble in boiling benzine. On extracting it with ether, a hard residue remains, which contains a paraffine whose melting point is  $79^{\circ}$ , and sp. gr. 0.939. This paraffine forms lustrous crystals and is very stable. It has been named *leken*.—*Celestite* has been found in three localities in Kansas, as announced by W. Knaus in the *Kansas City Review*.—A remarkably fine group of Japanese *stibnite* crystals has been recently purchased for the British Museum. The group consists of 120 crystals from one-half to two and a-half inches wide and thirteen inches long, the whole weighing 150 lbs.—Lippitt has found a native ferrous and aluminum sulphate from Mexico, which was a compact mass of flexible fibers resembling asbestos, of a greenish-white color and silky luster, with a hardness of 2 and spec. grav. 1.89. It was soluble in water, and analysis indicated that it corresponded to a mixture of two molecules of halotrichite and one of melanterite. The iron was all in the ferrous condition.—*Vivianite* occurs in brilliant, dark-blue crystals in the cavities of human bones taken out of a supposed Roman well near the pyrites mines of Rio Tinto, Sierra Morena.—Professor M. F. Heddle has found *topaz* associated with thorite, magnetite, amazon-stones, etc., in the syenite of Ben Loyal, Sutherland, Scotland.—*Idocrase* of a greenish-yellow color, and of unusually interesting crystallographic form, occurs at Kedabék, in the Caucasus, according to O. Korn. It has been shown by Jannasch that the idocrase from Vesuvius, Norway and elsewhere contains one per cent or more of fluorine.

#### BOTANY.<sup>1</sup>

GLANDS ON A GRASS.—In the latter part of August, 1883, while collecting various plants, my attention was attracted by some minute insects which appeared to be held fast to parts of the slender pedicels of one of our drop-seed grasses (*Sporobolus heterolepis*). An examination, by means of a hand-lens, showed these unfortunate insects to be adhering to small, dark-colored glistening swellings of the pedicels. Further examination showed these swellings upon most of the pedicels, and their slight stickiness to the touch quickly suggested their glandular nature. They were accordingly taken to the laboratory and carefully studied.

Upon making a cross-section of the swelling, the glandular tissue (*a*) was found to be disposed upon two sides of the section, with green tissue (*b*), and the fibrovascular bundles (*c d d*) and their accompanying masses of fibrous tissue (*e e*) occupying the remaining and interior parts, as shown in Fig. 1, of the accompanying camera sketches.

A higher power of the microscope showed the glandular tissue

<sup>1</sup> Edited by PROF. C. E. BESSEY, Ames, Iowa.

to be made of columnar radially-placed cells, which, from their relation to the contiguous tissues, are clearly to be regarded as modified epidermal cells. They were filled with minutely glandular contents (Figs. 2 and 3, *a*) of a faint amber color. Beneath the gland-cells there are several layers of chlorophyll-bearing cells (*b*).

A superficial view of the gland-cells showed them to be irregularly prismatic (Fig. 4). The outer walls are much thickened, as are also the lateral walls for some distance from the surface, these becoming gradually thinner as they pass inward, as shown in Figs. 2 and 3. For comparison, a superficial view of the ordi-

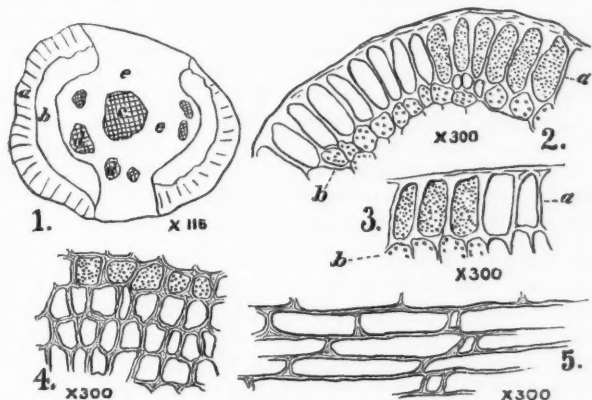


FIG. 1.—A cross-section of a glandular swelling; *a*, gland cells; *b*, green cells; *c*, and *d*, fibrovascular bundles; *e*, fibrous tissues. FIG. 2.—Cross-section of gland cells, *a*, and green cells, *b*. FIG. 3.—Longitudinal radial section of same. FIG. 4.—Superficial view of gland cells. FIG. 5.—Superficial view of ordinary epidermal cells of the pedicel, taken just above the glandular swelling. From camera lucida sketches.

nary epidermal cells of the pedicel, taken just above the glandular swelling, is here reproduced in Fig. 5.

These glands remind one, in their position, of the sticky belts upon the pedicels of certain species of Catchfly (*Silene*) and one is tempted to ask whether they have not the same functions in both cases.—*C. E. Bessey*.

SEXUALITY IN ZYGNEMACEÆ.—A paper was read [before the Linnean Society, Nov. 15, 1883] by Mr. A. W. Bennett, on the reproduction of the Zygnemacæ, as a solution of the question—Is it a sexual character? De Bary, twenty-five years ago, and since then, Wittrock, have instanced what they have deemed sexual differences between the conjugating cells, though most later writers rather ignore essential physiological distinctions. Mr. Bennett has directed his investigations chiefly to the genera Spi-

rogyra and Zygnema, and from these he supports the inference of the above-mentioned authors. He finds there is an appreciable difference of length and diameter in the conjugating cells, that deemed the female being the larger. The protoplasmic contents he also finds pass only in one direction, and change first commences in the chlorophyll-bands of the supposed male cells with accompanying contraction of the protoplasmic material. The genera *Mesocarpus*, *Staurospermum*, and the doubtful form *Craterospermum* have likewise been examined, and, though showing differences, yet on the whole substantiate the view above enunciated of cell sexuality."—*Nature*.

[In the case of hybridism in *Spirogyra*, described in the January *NATURALIST*, there were resting-spores in *both filaments*. The cell *A*, of the figure there given, was in the case of hybridism, functionally the male, but the next cell to the right contained a resting-spore, as is shown in the figure. Moreover, the right cell to the left of *B* [not shown in the figure] contained a resting-spore. This case would indicate that bi-sexuality must be confined in *A*, at least to individual cells, otherwise, we should have to consider this a case of conjugation between two female plants, which is manifestly absurd.—*C. E. Bessey*.]

SOME RECENT BOTANICAL ADVANCES.—Among the most significant of the recent discoveries in botany is that respecting the continuity of the protoplasm from cell to cell by means of delicate threads which traverse channels through the cell walls. It had long been known, that in the "sieve" tissues of higher plants there was such continuity through the "sieve plates," which imperfectly separated the contiguous cells. This may be readily seen by making longitudinal sections of a fibro-vascular bundle of a pumpkin stem, staining with iodine, and contracting the protoplasm by alcohol. Carefully made specimens of the soft tissues of many plants have shown a similar protoplasmic continuity, where it had previously been unsuspected. Some investigators are now inclined to the opinion, that protoplasmic continuity may be of universal occurrence in plants.

Tschirch regards it as probable, that Chlorophyll plays "not merely a physical, but also a chemical part in the process of assimilation." This is in opposition to Pringsheim's view, that the function of chlorophyll is that of a screen or shade.

It has recently been suggested that the act of sexual conjugation, that is, the union of two masses of protoplasm, may be regarded as "simply a strongly specialized instance of the absorption of nutriment." According to this view, what we call fertilization, is but the feeding of a cell upon the richest possible food, *i. e.*, material identical with its own substance. This rich food enables the cell, so greatly nourished, to perform the work of reproducing a new individual.

**BOTANY IN A MEDICAL COURSE.**—From *Nature* we learn that a most excellent course of study in botany is required in medicine, in England, as indicated by the examinations under the new rules which took effect in January of this year. These examinations "will have reference to the fundamental facts and laws of the morphology, histology, physiology, and life-history of plants, as illustrated by the following types: *Saccharomyces*, *Protococcus*, *Mucor*, *Spirogyra*, *Chara* or *Nitella*, a Fern, *Pinus*, and an angiospermous flowering plant."

Is there any medical school in this country, where such an intelligently arranged course in elementary botany is provided? Too often, alas, there is no *botany at all* in our medical courses.

**OBITUARY.**—The friends of science, and mycologists especially, will learn with regret of the death of Wm. T. Haines, Esq., who died suddenly at his residence in West Chester, Pa., on the 2d of February, 1884. Mr. Haines, in addition to his arduous legal duties, has for many years taken a deep interest in scientific pursuits, and especially in the investigation of the flora of his locality; and the many interesting species contributed to the North American Fungi, by him and his colleagues of the West Chester Mycological Club, will long keep his name in pleasant remembrance among those who turn over the pages of that collection.—*J. B. Ellis.*

**BOTANICAL NOTES.**—A fine engraving of the foliage and mature cones of *Dammara australis*, the Kauri Pine of New Zealand, is given in the *Gardener's Chronicle*, for October 27th, last. The number for November 3d, contains well-drawn life-size figures of our Yellow-water lily (*Nuphar advena*).—The October *Quarterly Journal of Microscopical Science*, contains an extended article by H. M. Ward, on the genus *Pythium*, accompanied by three double-page plates. We hope to present a summary of this paper ere long.—A proposal has been made in England to celebrate the bi-centenary of the discovery of bacteria (by Leeuwenhoek, in 1683), by the endowment of a National laboratory of hygiene, in which the study of the bacteria shall be one of the principal objects.—In the January *Torrey Bulletin*, Mr. Schrenk contributes some notes on Tuckahoe, accompanied by a plate. The evidence now adduced seems to indicate that tuckahoe is due to a sort of gummy degeneration of the tissues of some plant, and that the fungal threads present are saprophytic; the accompaniment not the cause.—In the same journal several new grasses are described by Mr. Scribner. One by Dr. Vasey, is dedicated to the well-known collector, A. H. Curtis. It is from Florida, and is named *Ammophila curtisii*.—The February *Botanical Gazette*, is an unusually interesting number, containing among other papers, one on Schweinitz (biographical), a Botanical Holiday in Nova Scotia, Notes on the N. A. forms of *Podosphæra*,

Additions to the Habitats of *N. A. Sphagna*. The General and Editorial Notes are full, and well selected. Among these we notice the discovery of a grass, *Graphephorum festucaceum*, from Northern Iowa. It has hitherto been known only from the Saskatchewan region, northwestward to Alaska. This northern grass may well serve as a companion with *Adoxa moschatellina*, also a far northern plant found a few years since in Northern Iowa.—General Benjamin Alvord, publishes in the Bulletin of the Am. Geographical Society, No. 4, a valuable paper on Winter grazing in the Rocky Mountains. Its chief interest to us in this place is its discussion of the grasses of that region.—We fell into an error in our notice (in the February NATURALIST) of very simple prothallia of a fern (*Onoclea struthiopteris*) grown by D. H. Campbell. The autheridia were not one-celled, as we understood from the drawing and description, but several-celled.

#### ENTOMOLOGY.

THE SPRUCE-BUD TORTRIX.<sup>1</sup>—The habits of this insect while in confinement were first studied by Professor C. H. Fernald, of the Maine State Agricultural College, Orono, Me., and his account published in the AMERICAN NATURALIST for January, 1881. In the account of the ravages of a caterpillar on the spruces on the coast of Maine in Bulletin 7 of the United States Entomological Commission, we refer to this insect, which we were unable to identify, as, after repeated search in the latter part of the summer, we failed to discover any traces of the insect in any stages. In our account we gave greater prominence to the operations of borers and bark beetles than to those of this caterpillar; and while considerable damage was undoubtedly done to spruces and firs in Sagadahoc and Cumberland counties by those beetles, from farther inquiries and field-work carried on in June and July, 1883, in different parts of Maine, we now have little doubt but that the destruction of spruces and firs along the coast of the State was mainly due to the attacks of this insect.

The different climatic causes alleged to destroy forest trees in general, would, in the present case, have injured pines and hardwood trees, as well as spruces and firs, and the destruction would have been general; whereas the trees have been killed by a caterpillar which we have never found upon pines nor any trees but spruce, fir, and occasionally the hemlock and larch. Individual trees, or clumps of trees, were attacked, whether in high and exposed situations or in hollows; occasionally from such centers the worms seem to have increased and spread from year to year, until all the trees in localities several square miles in extent were killed. Moreover, as we have seen in the case of the attacks of

<sup>1</sup>Extracted from the report of the Entomologist (Professor C. V. Riley) of the Department of Agriculture for 1883.



the larch worm, the defoliation of spruces and firs repeated two and perhaps three summers is sufficient to either kill the tree outright, or so weaken it that bark-boring beetles can complete the work of destruction. We are now inclined to the opinion, then, that the bud Tortrix is the sole or at least main cause of the destruction of spruces and firs in Cumberland and Sagadahoc and Lincoln counties, Maine, and that by their attacks they render the trees liable to invasion by hosts of bark beetles.

The spruce-bud worm, as we observed in Cumberland county, also at Phillips, and near the Rangeley lakes, on the road from Phillips to Rangeley, where the trees by the roadside, as well as in the woods, were attacked by them, so that they looked as if a light fire had passed through them; feeds upon the leaves or needles of the terminal shoots, both the first and previous year's growth. The worm gnaws the base of the needles, separating them from the twig, meanwhile spinning a silken thread by which the needles and bud-scales are loosely attached to the twig; the worm moving about in the space between the twig and the loosened needles and bud-scales, and not living, like many leaf-rolling caterpillars, in a regular tube.

The caterpillar sometimes draws together two adjacent shoots, but this is rarely done; hence while it is at work it scarcely alters the appearance of the tree, and its presence is only known when the worms are abundant enough to partly defoliate the trees.

The worms in June, 1883, were in Cumberland county most abundant where the dead or partially dead spruces abounded; but individual worms could be obtained by beating any spruce or fir in any locality, showing that in years of immunity from its attacks the insect is a common and widespread species. We found the worms most abundant in spruces, firs, and even hemlocks, July 1 and 2, between Phillips and Rangeley, but after passing through all the Rangeley lakes, and going from Errol, N. H., to Berlin, Gorham, Jackson, and Conway, N. H., we found that the spruces and firs throughout Northwestern Maine and the White Mountain region had suffered no widespread damage. One and perhaps two rather extensive tracts of dead spruces were observed at a distance from the stage road near Rangeley, but throughout the vast spruce-clad forests observable from the lakes themselves, no such tracts of dead trees were to be seen. On the contrary, the spruce forests of the Rangeley Lake region appeared to be as green and fresh as any forest we have ever seen. The dead spruces at the water's edge of the middle lakes were evidently due to the high water held in by the middle and lower dams during the last two years. As in any forest, there were individual dead trees, sometimes small clumps of them, where the trees had died as the results of tornadoes or of borers. The persons living by the lakes, lumbermen and others, informed us that there had been no extensive destruction of evergreen trees in this region.

The spruce-bud worm attains its full size and stops feeding, ready to transform to a chrysalis, in Cumberland county, by the 20th to 30th of June, and about the Rangeley lakes and in the White Mountain region a few days or nearly a week later.

When about to change to a pupa it remains in its rude shelter or hiding-place under the loosened leaves of the shoot, where it turns to a chrysalis, without spinning a regular, even, thin cocoon. It remains in the chrysalis state about six days. Those pupating at Brunswick, Me., June 28 and 29, issued as moths July 4 and 5. When the moth is ready to break forth from the pupa, the latter wriggles part way out of its hiding-place, and the moth issues, leaving the rent pupa skin projecting half way out of the end of the shoot. The moths then appear from the first to the middle of July. July 16, after our return from an absence of two weeks, we found that the moths of both sexes had issued, and that the females had laid their eggs in curious little patches on the sides of the breeding-box. They must have issued about the 5th to 7th of July, and immediately laid their eggs, as in one patch the shells were empty, with a small orifice in the shell, out of which the larvæ had crept. Another patch was found with a dark spot in each egg, showing the head of the embryo caterpillar; these hatched July 18, 19. It thus appears that the embryo develops, and the caterpillar hatches, in about ten days after the eggs are laid.

The eggs are very curious and very unlike those of most moths. They are pale-green, scale-like, broad, flat beneath, moderately convex above, oval cylindrical, a little longer than broad, and in all those which I examined, both those containing the embryos, and those which were empty, the surface, contrary to Professor Fernald's statement, was under a lens seen to be finely but irregularly granulated. The shell is thin, and at first unusually soft. Length, 0.9-1.4<sup>mm</sup>; breadth, 0.8-1<sup>mm</sup>. The patches were about 3<sup>mm</sup> in diameter, and composed of as many as 30 eggs. The eggs overlapped each other irregularly, leaving about a third or fourth of the surface of each egg exposed.

From the form and size of the egg-mass it is evidently attached by the moth to a terminal twig. The caterpillars on hatching do not, as Fernald observes, eat the shell. They hatch about or soon after the middle of July, and it is most probable that the caterpillars become partly, perhaps almost wholly, grown before the end of autumn, and pass the winter among the terminal shoots of the tree, to finish their transformations the following June and July. It is certain that there is but a single brood of caterpillars. Professor Fernald, in his article in the AMERICAN NATURALIST, describes the process of egg-laying. He has bred from the worms an ichneumon (*Pimpla conquisitor*), several dipterous parasites and a hair-snake. We have found the insect to be remarkably free from parasites, having bred about 25 of the moths without rearing any parasites.—A. S. Packard, Jr.

**NEST OF THE PSEUDO-SCORPION.**—In confirmation of the reference to this subject in "Packard's Guide to the Study of Insects," fourth edition, p. 658, I found, Feb. 5, 1884, a pseudo-scorpion, which had died in its nest, in the act of molting. The nest was made at the edge of a piece of paper lying on a beam in a garret. When the paper was removed, the nest still adhering to the edge, had its lower surface torn open, disclosing the dead insect. The nest (Fig. 1, under side, nat. size; Fig. 2, upper side, enlarged five diameters), was oval in outline, two-tenths of an inch long. Its lower surface was a flat, white web of extremely thin, translucent texture. Its upper surface was slightly convex, firmer and darker than the lower, and the entire edge was bordered with minute pieces of sawdust, firmly glued to the web. The insect was about half withdrawn from its old integument (Fig. 3, view from above; Fig. 4, view from the side, both enlarged five diameters).

This molted covering was entire, although wrinkled on the back, reaching nearly its original position at the head; but underneath it was ruptured on each side, from the head backwards to about two-thirds of its length, somewhat resembling a pair of opening oyster shells. The empty coverings of the large maxillary palpi were extended, in perfect condition, still bearing the prominent long hairs on the forceps. But the molted palpi themselves were bent downwards and backwards, with their tips extending under the abdomen, where also all the legs were gathered with their tarsi placed together.—*J. L. Zabriskie, Nyack, N. Y.*

**ENTOMOLOGICAL NEWS.**—*Papilio* closes its third volume with an excellent triple number. The transformations of *Hemaris unifornis*, *Darapsa chærilus*, *Cressonia juglandis*, *Sphinx chersis*, *Phragmatobia rubricosa*, *Deiopeia bella*, *Parasa chloris*, *Limacodes scapha*, *Adoneta spinuloides*, *Gluphisia trilineata*, *Notodonta stragula*, *Cedemasia concinna*, *Cerura cinerea*, *Tolyte velleda* and *laricis* and several Noctuids, with the geometrid *Amphidasis cognataria*, are described by H. Edwards and S. L. Elliott. Mr. H. Edwards limits the species of *Euchetes*, and shows by Mr. Elliott's observations on the larvæ, that *E. collaris* is a different species from *E. eglenensis*. The genus *Arctia* and its variations are discussed by B. Neumogen with the result of reducing several so-called species to varieties. Mr. W. H. Edwards comments at length on Hagen's views on the genus *Colias*; while W. Schaus, Jr., de-



Pseudo-Scorpion's nest.

FIG. 1.—Under side of nest, nat. size. FIG. 2.—Upper side of nest, enlarged. FIG. 3.—Pseudo-scorpion view from above. FIG. 4.—Do. view from the side.—*J. L. Zabriskie.*

scribes the early stages of some Mexican Lepidoptera. We regret to notice that Mr. Edwards is unable to conduct this very successful journal, which will hereafter be published by Mr. E. M. Aaron, P. O. Box 2500, Philadelphia, Pa.—An elaborate essay on the thoracic muscles of insects, by C. Luke, appears in the *Jena Zeitschrift*, for Oct. 13, '83. With the exception of the Thysanura (including the Collembola) insects of all orders have been examined.—The Quarterly Journal of the Boston Zoölogical Society, for Jan., prints valuable notes on the habits and metamorphoses of *Hydrocharis obtusatus* and *Magdalis olyra*, by F. C. Bowditch.—Dr. Hagen states in the *Entomologist's Monthly Magazine*, for Jan., that he saw at Wood's Holl *Anax longipes* preying upon *Papilio asterias*, catching them and settling on a shrub to behold and devour them. This is a rare southern form.—A case of sex-dimorphism in the Psocidæ is noticed by Ph. Bertkau (*Archiv. für Natur.*, 1883). In *P. heteromorphus* the wings of the male are long, while those of the female are short. In *Trocticus gibbulus*, n. g. and sp., the wings are short in both sexes. *Lapithes pulicarius* is a wingless Psocid, which differs from other wingless genera in the antennæ, palpi, and maxillæ. Dr. Otto Geise (*loc. cit.*) gives a minute description of the mouth parts of the Rhynchota, as exemplified by *Notonecta glauca*, *Nepa cinerea* and *Corixa striata*.—H. J. Kolbe. (*Archiv. für Natur.*, 1883) characterizes forty-three species of Dytiscidæ from Madagascar, in the entomological museum of Berlin, and diagnoses twenty other species found in Madagascar, as well as six found on the surrounding islands only. The usual world-wide genera occur in Madagascar, but numerous small species are peculiar. Genera, not common to Madagascar and the Oriental region, do not occur in Australia. The genera *Bidessus* and *Cope-latus*, which are probably oldest phylogenetically, are most abundant in Australia, and occur but sparsely in Asia, Africa, and Madagascar. Most of the genera are richer in species in Madagascar and the Oriental region than in Africa. The smallest species are nearer to those of the Oriental and Australian fauna, than to those of Ethiopian; and, on the whole, the Dytiscidæ of Madagascar are nearer those of the two former faunæ than they are to those of the latter.—Mr. G. C. Chapman relates in the *Entomologist's Monthly Magazine*, for January and February, his interesting experiences during four years' collecting in Central America, where he obtained not less than 15,000 species of insects, the greater part of which will probably be catalogued in Godman and Salvin's Zoölogy of Central America.—Obituary notices of the late Dr. John L. LeConte, by Professor J. P. Lesley and Dr. Horn, were read before the American Philosophical Society; in the latter's notice it is stated that LeConte described more than 500 genera and nearly 5000 species, three-fourths of the latter remaining valid; but, it is added, that his work was notable for his breadth of view as well as analytical powers.

## ZOÖLOGY

TREMATODE PARASITES IN AMERICAN CRAYFISH.—Professor Kellicott has recently called attention to the fact that American crayfish are subject to invasion by Trematode parasites.<sup>1</sup> His remarks have recalled to me some observations which I made in 1879, and which I now record, because in the interval the Distomes of the European *Astacus fluviatilis* have been subjected to renewed examination,<sup>2</sup> and one of them has been accused as the cause of the pest, which has, within the last five years, effected such ravages in the crayfish tanks of France and Germany.

Two Distomes are found abundantly in *Astacus*—*D. isostomum* Rudolphi, and *D. cirrigerum* v. Baer. The former lives free in the body cavity, is immature, measures between 2 and 3<sup>mm</sup> in length, and is immediately recognized by the equality in diameter of its anterior and ventral suckers. According to Harz, it is harmless to its host, and Zaddach thinks that it is developed from the eggs of *D. cirrigerum*.

It is my impression that I have also met with *D. isostomum* in American crayfish, but the only specimens I have preserved are from Germany.

*D. cirrigerum* is always encysted, is most abundant in the muscles of its host, and produces, according to Harz, the crayfish pest, which has consequently been styled a "Distomatosis." Zaddach, v. Linstow and other observers contest this view, believing that, after encystment, the Distomes can occasion little or no inconvenience. Although an encysted form, *D. cirrigerum* produces eggs, and is, of course, self impregnating. The minute encapsuled forms described by Professor Kellicott, are very probably young stages of this species.

In my collection of Trematoda, I find one which I marked, when discovered, "*D. nodulosum* Zeder, from a cyst in the ovary of *Cambarus*," probably *C. propinquus*. This species (Fig. 1), belongs to a small group of Distomes in which the anterior

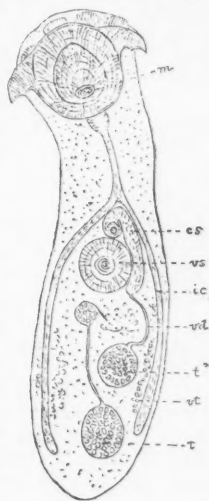


FIG. 1.—*M*, the mouth in the anterior sucker; *cs*, the sac of the cirrus opening in front of *vs*, the ventral sucker; *ic*, one of the intestinal caeca; *vd*, vas deferens leading directly from the anterior testis to *cs*; *vt*, the vitellogen; *t*, the posterior testis, the vas deferens of which appears to end in a vesicula seminalis, between which and *vd* is the blastema for the ovary.

<sup>1</sup> Proc. Am. Soc. Microscopists, Chicago Meeting, 1883, p. 115.

<sup>2</sup> C. O. Harz. "Die sogenannte Krebspest, &c." Wien, 1881. Rev. by Dr. v. Linstow in Bericht über nied. Thiere in Archiv. für Naturg., 1883.

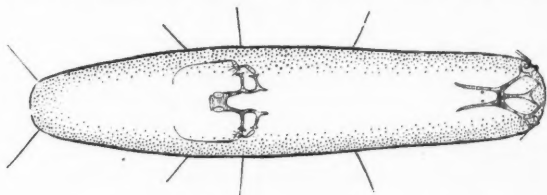
G. Zaddach. Zoöl. Anz., 1881, 398 and 426.

sucker is produced into papillæ, and is found free in the intestinal canal of various European fresh-water fish (*Perca*, *Lucioperca*, *Esox*), and encysted on the outer surface of the intestine in *Acerina*. V. Linstow<sup>1</sup> indicates *Paludina impura* as the intermediate host into which the cercariæ of *D. nodulosum* penetrate and encyst themselves. Their presence in an encapsuled condition in *Acerina* he explains by supposing that the cercariæ have either wandered directly into the little fish, or that they have been swallowed while still free in the mollusk.

My specimen resembles the encysted state from *Acerina* in the fact that only the male organs are developed, the few female organs being undifferentiated. The structure of the mouth suckers is not entirely in accordance with v. Linstow's description. As far as I can make out from my only specimen, the periphery of the sucker is prolonged at the sides anteriorly into two somewhat triangular flaps, and its muscular wall is pushed out in front into four papillæ.

I have not met with *D. nodulosum* as a fish parasite, but it is probably to be found mature in the intestinal canal of various fresh-water fish. It remains to be seen whether the crayfish is normally the intermediate host. The researches of the late Professor Ercolani<sup>2</sup> have shown how easily some Trematodes accommodate themselves to new surroundings, and it is quite possible that this solitary specimen of *D. nodulosum* had merely "wandered" into an unaccustomed host.—R. Ramsay Wright, *School of Practical Science, Toronto*.

**PTEROLICHUS FALCIGER** MEGNIN, OBSERVED IN THE UNITED STATES.—The "nymphæ hypopiale" (*Hypoderas columbæ* Murray) of this mite has been noticed by the writer on several occasions in the tissues of the domestic pigeon. As stated by Robertson, it occurs most abundantly in the connective tissue about the large veins near the heart, but a few may be found under the skin in the region of the arm-pit. It is an elongate, sack-like, whitish body, about 1.5<sup>mm</sup> long, with smooth surface, and very short legs, the two anterior pairs of which are widely separated from



Nymphæ hypopiale of *Pterolichus falciger*, enlarged.

the two posterior pairs. No mouth-parts are visible with one of

<sup>1</sup> Arch. für Naturg., xxxix, 1873, p.

<sup>2</sup> Dell' adattamento della specie all' ambiente. Bologna, 1881-2.

Spencer's 1-10 inch immersion objectives, and as these appendages can be seen with ordinary objectives in very much smaller mites than this, it is safe to assume that there are none. The character of the legs, with their chitinous rings and highly-developed epimera, would seem to be sufficient to place this form with the Sarcophtidæ, even if none of the other stages existed. The legs are not terminated by two hairs, as is supposed by some writers, but in the three anterior pairs by a long claw with a slightly swollen tip, which probably represents the tarsal sucker of the normal form.—*H. Garman.*

ON THE MORPHOLOGY OF THE "LATERAL RODS" OF THE OPHIUROID PLUTEUS.—Two groups of Echinoderms, the Ophiuroidea and the Echinoidea, have a larval stage in their development, which is known as a pluteus. In both of these groups the larval appendages, unlike those of the young of other Echinodermata, have the form of long calcareous rods, encased in a covering like that which forms the fleshy walls of the body.

Homologues of all these appendages or rods of the Ophiuran pluteus have been found in those of the Echinoid, with the exception of by far the most prominent pair, which is first to appear and last to be absorbed and known at the lateral arms.<sup>1</sup> These are not commonly mentioned as existing in the pluteus of the Echinoid genera, and many authors say that they are unrepresented. On the other hand a pair of appendages, which seems to be without homologues in the pluteus of the Ophiuran, exists in the pluteus of certain genera of Echinoidea, as *Arbacia*, and are called the "apical" or "anal" rods or appendages. The lateral rods of the Ophiuran larva bear so many resemblances to these so-called anal appendages of *Arbacia*, that it seems natural to homologize the one pair with the other.

A new pluteus from the Bermudas, a description of which I hope later to publish, seems to stand intermediate between that of *Arbacia* and the young Ophiuran in respect to the size, and comparative development of the lateral or apical arms. It supports in all particulars the homology of these two appendages which I have pointed out above.

The relative time at which the development of the lateral arms in the pluteus of Ophiurans takes place, and that when the apical rods of *Arbacia* develop, may not seem to support the theory which has been advanced in regard to their homology. The lateral rods of the Ophiuran pluteus are among the first of these appendages to develop, while the posterior pair of arms in *Arbacia* are well developed, and the so-called antero-lateral are far along in growth, before any trace of the apical rods appears. This order of development would seem a fatal objection to the pro-

<sup>1</sup> The nomenclature of the arms adopted here is that used by Balfour in his *Comparative Embryology*, Vol. 1, page 470.

posed morphological identity of the two, if the time of their appearance is the only index of homology in Echinoderm larval appendages. The comparative anatomy of the rods of the body of the pluteus seems to me to point without doubt to an homology of the lateral arms of Ophiuran larval and the apical rods of Arbacia. All the appendages of the various forms of Echinoderm larvæ may be regarded as specially, or perhaps independently acquired structures, which are destitute of any great value, comparatively speaking, as far as the phylogeny of the Echinoderms is concerned. If I am right in looking at them in this way, the stages of growth in which the larva of Arbacia and the Ophiuran was, when on the one hand an apical<sup>1</sup> pair of rods, and on the other the lateral arms appear, need not coincide and yet the two may be homologically the same.—*J. Walter Fewkes.*

PLATEAU'S RESEARCHES ON THE ABSOLUTE FORCE OF THE MUSCLES OF BIVALVES.<sup>2</sup>—The great *apparent* force of the adductor muscles of lamellibranch mollusks is a fact universally known, and which forms the basis of La Fontaine's fable of the rat and the oyster. Fishermen and naturalists have made this the subject of interesting remark. Thus Darwin, speaking of the great *Tridacna* of tropical seas, says, that any one imprudent enough to introduce his hand between their valves, would be unable to withdraw it while the animal lived. Léon Vaillant relates that the divers whom he employed at Suez, and who procured him specimens of *Tridacna elongata*, advised him not to touch these animals on the side of the opening of the shell.

Plateau then adds: "I myself, in the course of experiments related in this notice, have been witness, whenever I wished to, in *Mya arenaria*, of a fact at first sight very surprising; if in the living mollusk we break, with the aid of a knife or forceps, a small area of the shell in the neighborhood of the hinge, a crackling noise is heard, and we see the valves open and striking together with a loud noise under the influence of the traction of the adductor muscles."

Darwin's observations on the transportation of *Unio* suspended by its closed valves to a duck's foot; of a *Cyclas* fixed in the same way to the foot of a water-beetle (*Dytiscus*), and of *Cyclas* attaching itself to the foot of a triton so as to amputate it, are noticed before speaking of the observations of others who submitted the adductor muscles to experiment.

Noticing A. Fick's experiments on the elongations, etc., which the adductor muscles of Anodonta; those of L. Vail-

<sup>1</sup> From what has been said it is thought proper to suggest the name lateral rods to designate these appendages as well as their homologues in the Ophiuroid for which it has long been used.

<sup>2</sup> Recherches sur la force absolue des muscles des invertébrés. Prem. Partie. Force absolue des muscles adducteurs des mollusques Lamellibranches. Par M. Professor Felix Plateau. Extrait du Bulletins de l'Académie royale de Belgique, VI, 1883, 8vo, pp. 36.

lant on the measurement of the force displayed by the adductors of bivalves, he refers at some length to those of A. Coutance, made especially on the *Pecten maximus*.

Plateau then describes at length his own interesting experiments, from which he draws the following conclusions:

1. The only way to carefully compare the muscular force of lamellibranch mollusks with that of the higher animals consists in estimating the absolute forces of the muscles by the square centimeter of transverse section.

2. The result of this comparison shows that the absolute force of the adductor muscles of Lamellibranchs is analogous to the absolute force of the muscles of vertebrates. The reader will probably make the remark that the fibers of the adductor muscles of the bivalves are generally smooth, while the muscles of animal life of vertebrates are composed of striated fibers. The objection is a serious one; but with the result to place me in the best possible condition, since I have undertaken some researches of the same kind on the Crustacea. The muscles of these articulates are striated, and present a texture very near to that of vertebrates.

THREE NEW FAMILIES OF FISHES ADDED TO THE DEEP-SEA FAUNA IN A YEAR.—In addition to the family of Eurypharyngids, fully described lately by Mr. Ryder and myself, two new family types were added to the deep-sea fauna by the explorations of the U. S. Fish Commission on steamer *Albatross* in 1883. These will be called *Derichthyidæ* and *Stephanoberycidæ*.

The *Derichthyids* are represented by one specimen, which has an eel-like form, a serpentiform head, with *well developed maxillaries*, as well as palatines, both bearing bands of teeth, a *well defined neck*, and the scapular arches remote from the skull. The color is a ruddy brown. Mr. Ryder and myself will describe the form at length under the name *Derichthys serpentinus*. It appears to be the type of a new order, and is especially interesting as being the only fish (so far as I recollect), with a true neck. Some may urge *Hippocampus* as a necked fish, but the doing so would be quite improper, for the contracted portion is behind the pectorals.

The *Stephanoberycides* appear to be *Berycoidea*, with abdominal or subabdominal ventrals, a dorsal of articulated rays, a caudal with numerous spinous rays in the procurrent upper and lower extensions, a cavernous head, toothless palate, and scales with spinous surfaces. It includes my *Stephanoberyx monæ* and *Acanthochænus lütkenii*; the latter has abdominal ventrals and branched rays, thus differing from *Stephanoberyx*, but it is not absolutely impossible that it may prove to be merely the mature form of the other, which was based on a small specimen.

Another interesting fish, from the same collection, is an Alepocephalid, with the body as well as head scaleless, which I shall describe as *Aleposomus copei*.—*Theodore Gill*.

ZOOLOGICAL NOTES.—Dr. C. Bulow (*Archiv. für Naturgeschichte*, 1883) gives the result of experiments on the subject carried on by him at Rostock. Bonnet beheaded a worm eight times, and regeneration followed each time, but the ninth time only a bud appeared. The results obtained by Reaumur, O. F. Müller, and others, are recapitulated. From the results obtained it is concluded that the head of an earth-worm is composed of eight segments, occasionally of nine, but more often of a smaller number, especially when the animal is cut into relatively small parts. When the new head does not contain the normal number of head-segments, the mouth-parts always serve their purposes. If a worm be cut in pieces, each containing eight or nine segments, each piece is tolerably sure to become a perfect worm. When a worm was cut into fourteen pieces, one died, but the rest reproduced both head and tail.—Dr. v. Linstow (*Archiv. für Naturg.* 1883) describes the Nematodes, Trematodes, and Acanthocephali gathered in Turkestan by Professor Fedtschenko. The number of Nematode species (76) is large, compared with that of the Trematoda (15), and of the Acanthocephali (3), but this is accounted for by the fact that the larvæ of the two latter families live in aquatic invertebrates, which are scarce in the unwatered plateau of Turkestan. Eighteen new species of parasitic nematodes are described, including an *Ascaris* of the sturgeon, one of *Silurus glanis*, and one of *Pastor roseus*; a Physaloptera of *Tropidonotus hydrus*; a Filaria of *Phalacrocorax carbo*, and one of *Turdus atrogularis*; *Aprocta cylindrica* from *Petræa cyanea*; *Heterakis curvata* from *Perdix græca*; *Oxyuris inflata* from *Pterocles arenaria*, and *O. lanceolata* from certain insects. All the species of Gordius and Mermis (8) appear to be new. Of the Acanthocephali two species of Echinorhynchus, from *Petræa cyanea* and *Astur palumbarius*, respectively, are new, as are six forms of Distomum and one of Monostomum among the trematodes.

*Amphibians and Reptiles*.—M. P. Albrecht notes the presence of true ossified epiphyses upon the spinous processes of many of the vertebræ of *Hatteria punctata*, strikingly resembling the same epiphyses in mammals. The skeleton examined (an adult) had, besides the pro-atlas, 8 cervical, 17 dorso-lumbar, 2 sacral, and 15 caudal vertebræ. The extremity of the tail was in neogenesis. A pair of these epiphyses occur on the 7th and 8th cervicals, and on the dorso-lumbars from the 2d to the 10th, inclusive, and on the 14th and 15th of that series. The remaining two dorso-lumbars, the sacrals, and the first four caudals have a single epiphysis evidently formed by the union of the right and left elements. The epiphyses increase in size to the 16th dorso-lumbar, and thence diminish.—D. J. v. Bedriaga (*Archiv. für Naturg.*, 1883), gives descriptions of the Amphibia and Reptilia of Corsica, which he states to be zoologically almost an unknown

land. He also devotes a large space to the external and internal characters, variations, and development of *Megapterna montana* Savi, and a list of its numerous synonyms, which include the generic names of Triton, Molge, and Euproctus. He believes that the genus Triton should be held to include not only Triton proper, but also Hemitriton, Pelonectes and perhaps Euproctus and Megapterna. Other Corsican amphibia are *Salamandra maculosa*, *Hyla viridis*, *Discoglossus pictus*, *Rana esculenta* sub sp. *viridis*, and *Bufo variabilis*. Our author distinguishes two species of Euproctus, *E. rusconii*, found in Sardinia, and *E. pyrenæica*, a native of Spain, Portugal, and the Pyrenees. The Reptilia of Corsica are *Tropidonotus natrix*, *Zamenis gemonensis*, *Platydictylus mauritanicus*, *Notopholis fitzingeri*; *Lacerta oxycephala*, *L. muralis*, and *L. viridis*, *Vipera aspis*, *Emys orbicularis*, and *Testudo græca*.

*Birds.*—Among the more valuable articles in *The Auk*, for January, are Mr. Brewster's notes on the summer birds of Berkshire county, Mass.; Mr. N. S. Goss' notes on the breeding habits of the American eared grebes; and Mr. Bicknell begins an interesting study of the singing of our birds, to be continued in the next number. After speaking of the connection between molting and the songs of birds, and of song as the result of mental excitement, of singing while on the wing, the author treats of seasonal variation in song; vocal variation with age; individual vocal variation and abnormal vocal variation.—From the "general notes" we glean the following items: Mr. Montague Chamberlain saw two crows successively charge upon a robin's nest and each fly away with an unfledged robin in its claws. Mr. J. W. Fewkes records the observation of several persons near Cashport, who declared that the crows take up in their claws sea-urchins and carry them up away from shore. "One intelligent person, not a naturalist, said he had observed the crows *transporting them in their claws*."—The nesting habits and eggs of the ruby-crowned kinglet; of *Myiodesetes townsendi*; of the saw-whet owl; of the broad-winged hawk; and a newly discovered breeding place of Leach's petrel in Rona, one of the Hebrides, are described. The black-throated auk, a North Pacific sea-bird, is recorded as occurring in Wisconsin.

*Mammals.*—The beautiful chromo plates illustrating the first volume of the mammals of Brehm's Thierleben, are well worthy of examination, and the publication of these superb colored plates will confer a new value on what is a standard popular work. The plates illustrating the lion, tiger, leopard, puma, but more especially the orang, chimpanzee and the gorilla, are as successful as any. These plates can be had of B. Resteimann & Co., New York.

PHYSIOLOGY.<sup>1</sup>

LOCALIZATION OF FUNCTION IN THE BRAIN.—The question at present of most fundamental interest in the physiology of the brain is, whether the various functions of the mind are delegated to special nervous centers of the cerebral cortex; in other words, is or is there not, localization of function in the brain. It is admitted by all physiologists that ordinary involuntary actions, like those of respiration, deglutition, &c., are aroused by impulses proceeding from pretty definitely localized nervous centers; but it has been a question of serious dispute as to whether psychical functions are likewise anatomically distributed over the nerve-cell—containing cortex of the cerebrum. Dr. Ferrier, of London, and Professor Goltz, of Strassburg, have been the chief exponents of the two extreme views on the subject. The former, in accordance with the results of numerous experiments upon monkeys, has mapped out the surface of the brain into numerous areas, each of which was supposed to be the seat of origin of voluntary motor impulses for a definite group of muscles, or, it might be, the place where certain special sensations were elaborated. Extirpation of that area would annihilate that function, and stimulation of it would call the function into play. The principal objection to Ferrier's experiments, that his animals were not allowed to live long enough after the operation to give fair chance of recovery from the effects of the shock, has been set aside in the case to be considered, that of a monkey which was killed and submitted to post-mortem examination after having lived in health for seven months succeeding an operation on the left side of the brain. Professor Goltz, working on dogs, has come to widely different conclusions from those of Dr. Ferrier. Goltz finds, in general, that destruction of any part of the cerebral cortex would cause the same paralysis or loss of sensation as that of any other part, in cases where the effect was positive. If the lesion were not too extensive, perfect recovery was gradually attained. But by destroying more and more of the cortex on both sides of the brain, partial paralysis of voluntary motion and loss of sensibility were diffused further over the body and became intensified, and, to some extent, permanent. At the same time the purely psychical powers lost their acuteness until, when nearly the whole of the cerebral cortex was removed, the result was almost total annihilation of the powers of judgment and perception. According to Goltz, the sole function of the cerebrum is to serve as the seat of the purely psychical powers, and any loss of sensation or of motion, which may result from injury to it, are the indirect effects of enfeebled perception. Goltz attributes the definite paralyses and losses of sensation, obtained by Ferrier, to direct inhibition of these functions due to inhibitory influences proceeding from the injured parts.

<sup>1</sup>This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

At the meeting of the International Medical Congress, held in London, in 1881, Goltz exhibited a dog, and Drs. Ferrier and Yeo a monkey, both of which animals had months previously been subjected to cerebral operations, and had long been in complete health. After a study of animals by members of the Congress, a committee was appointed, consisting of Mr. Langley, Dr. Klein, and Professor Schäfer, to make anatomical and microscopical examinations of the two brains. The committee has recently presented an exhaustive report on the subject submitted to it.

The dog, when still alive, when let loose in a room, wandered with wagging tail, hither and thither, carefully avoiding obstacles and using his muscles in a perfectly normal manner, with the exception of an occasional slipping of the feet upon the floor, and rather general clumsiness of movement. It was clear that the animal possessed the senses of hearing, sight and touch; but the perceptions usually aroused by these sensations were absent. Thus threatening with the voice or a whip produced no sign of fear. A lighted candle brought suddenly close to the dog's eye was noticed only by an indifferent blink. A patch of sunshine or some bright substance on the floor was carefully avoided as if it had been a solid object.

To use now the words of the report: "Professor Ferrier, London, called attention to the condition of the monkey which he had alluded to in his remarks at the morning meeting; the motor area of the left hemisphere had been extensively destroyed seven months previously. The animal was in every other respect sound, except as to the movements of the right arm and leg. The condition of these was recognized as bearing the closest resemblance to hemiplegia of some duration in man—M. Charcot remarking: 'it is a patient'! The movements of the leg were seen to be greatly impaired, and the arm quite powerless, being maintained flexed at the elbow, the thumb bent on the palm, and the fingers semi-flexed. The animal took pieces of food offered it with its left hand, and neither in its struggles to get free, nor on any occasion whatever, did it show any volitional action with its right hand or arm." One of the chief difficulties in the way of the committee which made the post-mortem examination of the two brains, was to determine the homologies of the various parts of the organs. This could not be done with certainty. The destruction of the dog's cerebrum was somewhat more extensive on the right side than on the left. There appears to have been complete and deeply extended destruction of about three-fourths of the substance of the cerebrum; the parts of the cortex remaining intact included the anterior fourth, the superior and inferior median-lateral portions. Most of the so-called "motor" areas appear to have been included in the lesion.

In the monkey it was found that the greater part of the two central convolutions, together with adjacent parts of the frontal

and parietal lobes, had been removed on the left side of the brain. Secondary disturbances in the body of the organ had probably made the lesion physiologically more extensive than appeared from the surface. The pyramidal tract of fibers in the spinal cord, which is in connection with the cerebrum, was found to be degenerated throughout its whole extent.

To a disinterested person it seems, from the evidence here offered, that Goltz has shown conclusively the absence of localization of function, as that term is commonly understood, for the brain of the dog, while Ferrier has failed to completely establish his theory of localization of function for the brain of the monkey. —*Four. of Physiology*, Vol. IV, Nos. 4 and 5.

WRITING WITH THE VOICE.—At a meeting of the College of Physicians, last week, Professor Harrison Allen, of Philadelphia, showed a new and very interesting discovery by which spoken language can be represented by a series of curved lines on a receiving surface composed of white paper coated with soot (Ludwig's lymographion). The experiments, which were originated by Professor Allen, from observations which he had made through watching the movements of the soft palate when conducting experiments connected with the human throat, are made with an instrument designed by the professor, and which is very simple and easy of operating. By means of his device he is enabled to register upon the surface of the sooted paper the lines and curves that represent the various phonetic sounds of the human voice. His observations have proved that the discovery will undoubtedly be of great importance in diagnosing cases of diseases of the palate, and in studying the causes of stammering.

Professor Allen has already shown, by means of his interesting experiments, that many of the sounds which have long been considered by elocutionists to be formed by the direct action of the lips, the teeth, or the tongue, are in reality formed primarily by the action of the palate. The subject is sure to prove one of much importance to the world of science, and the professor thinks it will develop some most interesting facts. Dr. Allen calls his instrument the palate-myograph.

#### PSYCHOLOGY.

GREGARIOUS AND SLAVISH INSTINCTS.—In his very readable "Inquiries into Human Faculty and its Development," Mr. Galton discusses what he regards as a curious and apparently anomalous group of base moral instincts and intellectual deficiencies that are innate rather than acquired. His method is to trace their analogies among the brutes, and to examine the conditions through which they have been evolved. His argument is, that gregarious brute animals possess a marked want of self-reliance,

that the conditions of the lives of these animals have made a want of self-reliance a necessity to them, and that by the law of natural selection the gregarious instincts and their accompanying slavish aptitudes have gradually become evolved. He then argues that our remote ancestors lived under parallel conditions, and that we have inherited the gregarious instincts and slavish aptitudes which have been needed under past circumstances, but which in our present advancing civilization are becoming of more harm than good to our race.

Reference is then made to the camel, whose urgent need "for the close companionship of his fellows was a never-exhausted topic of curious admiration to me during tedious days of travel across many North African deserts. I also happened to hear and read a great deal about the still more marked gregarious instincts of the llama, but the social animal into whose psychology I am conscious of having penetrated most thoroughly, is the ox of the wild parts of Western South Africa."

These oxen belonged to the Damaras, and none of the ancestry of these cattle had ever been broken to harness. Nearly a hundred of these beasts were broken in dragging the wagon, packs and saddle, and on one of them Mr. Galton rode. After such an intimate acquaintance with and study of these cattle, he writes: "The better I understand them, the more complex and worthy of study did their minds appear to be. But I am now concerned only with their blind gregarious instincts, which are conspicuously distinct from the ordinary social desires. In the latter they are deficient; they are not amiable to one another, but show, on the whole, more expressions of spite and disgust than of forbearance or fondness. The ox cannot endure even a momentary separation from his herd. If he is separated from it by stratagem or force, he exhibits every sign of mental agony; he strives with all his might to get back again, and when he succeeds he plunges into its middle to bathe his whole body with the comfort of closest companionship."

It was found very difficult to procure animals capable of acting the part of fore-oxen to the team, "The ordinary members of the wild herd being wholly unfitted by nature to move in so prominent and isolated a position, even though, as is the custom, a boy is always in front to persuade or pull them onwards. Therefore, a good fore-ox is an animal of an exceptionally independent disposition. Men who break in wild cattle for harness watch assiduously for those who show a self-reliant nature, which is shown by their grazing apart or ahead of the rest, and these they break in for fore-oxen." These wild oxen, Galton concludes, are "essentially slavish, and seek no better lot than to be led by any one of their number who has enough self-reliance to accept that position. No ox ever dares to act contrary to the rest of the herd, but he accepts their common determination as an authority

binding on his conscience." He then goes on to say that "an incapacity of relying on oneself and a faith in others are precisely the conditions that compel brutes to congregate and live in herds; and, again, it is essential to their safety in a country infested by large Carnivora, that they should keep closely together in herds."

An ox feeding alone is easily surprised, yet a crouching lion fears cattle who turns boldly upon him, as they can make ugly wounds with their horns in the paw or chest of a springing beast. Hence, a cow who has calved by the wayside, and is restless and eager for the safety of her calf, even when temporarily abandoned by the caravan, is never seized by lions. Ordinarily, however, when grazing, their heads buried in the grass, or while ruminating, they are peculiarly liable to attack.

Galton's account of a herd of oxen and their relation to their environment is well worth quoting: "But a herd of such animals, when considered as a whole, is always on the alert; at almost every moment some eyes, ears and noses will command all approaches, and the start or cry of alarm of a single beast is a signal to all his companions. To live gregariously is to become a fiber in a vast sentient web overspreading many acres; it is to become the possessor of faculties always awake, of eyes that see in all directions, of ears and nostrils that explore a broad belt of air; it is to become the occupier of every bit of vantage ground whence the approach of a wild beast might be overlooked. The protective senses of each individual who chooses to live in companionship are multiplied by a large factor, and he thereby receives a maximum of security at a minimum cost of restlessness."

Natural selection tends to give but one leader to each suitably-sized herd, and to repress superabundant leaders. Moreover, there is "a certain size of herd most suitable to the geographical and other conditions of the country; it must not be too large, or the scattered puddles, which form their only watering places for a great part of the year, would not suffice, and there are similar drawbacks in respect to pasture. It must not be too small, or it would be comparatively insecure," as a troop of five animals are more easily approached by a lion or hunter than a larger one.

The leaders of the herd are safer than those self-reliant animals which graze apart; it is precisely these which are seized by lions. "The leaders are safe enough from lions, because their flanks and rear are guarded by their followers; but each of those who graze apart, and who represent the superabundant supply of self-reliant animals, have one flank and the rear exposed, and it is precisely these whom the lions take. Looking at the matter in a broad way, we may justly assert that the wild beasts trim and prune every herd into compactness, and tend to reduce it into a closely-united body with a single well protected leader. That the development of independence of character in cattle is thus suppressed below its

otherwise natural standard by the influence of wild beasts, is shown by the greater display of self-reliance among cattle whose ancestry for some generations have not been exposed to such danger."

What is said of cattle applies also to savages and barbarians. The inhabitants of the same country as the oxen described, are congregated into multitudes of tribes, all more or less at war with one another. "We shall find that few of these tribes are very small, and few very large, and that it is precisely those that are exceptionally large or small whose condition is the least stable. A very small tribe is seen to be overthrown, slaughtered, or driven into slavery by its more powerful neighbor. A very large tribe falls to pieces through its own unwieldiness, because, by the nature of things, it must be either deficient in centralization or straitened in force, or both." Reference is also made to the extraordinary power of tyranny invested in the chiefs of tribes and nations of men, which leads to slavishness on the part of the subjects. "The tyrannies under which men have lived, whether under rude, barbarian chiefs, under the great despotisms of half-civilized Oriental countries, or under some of the more polished but little less severe governments of modern days, must have had a frightful influence in eliminating independence of character from the human race."

"Our present natural disposition make it impossible for us to attain the ideal standard of a nation of men, all judging soberly for themselves, and, therefore, the slavishness of the mass of our countrymen, in morals and intellect, must be an admitted fact in all schemes of regenerative policy. The hereditary taint due to the primeval barbarism of our race, and maintained by later influences, will have to be bred out of it before our descendants can rise to the position of free members of an intelligent society; and I may add that the most likely nest at the present time for self-reliant natures will be found in States founded and maintained by emigrants."

TEACHING ANIMALS TO CONVERSE.—Commenting in *Nature* on Miss Martineau's remark, that considering how long we have lived in close association with animals, it is astonishing how little we know about them, and especially about their mental condition, Sir John Lubbock goes on to say, that he believes that it arises very much from the fact, "that hitherto we have tried to teach animals, rather than to learn from them, to convey our ideas to them, rather than to devise any language, or code of signals, by means of which they might communicate theirs to us. No doubt the former process is interesting and instructive, but it does not carry us very far. Under the circumstances, it has occurred to me, whether some such system as that followed with deaf mutes, especially by Dr. Horn with Laura Bridgman, might not prove very instructive if adapted to the case of dogs.

"Accordingly, I prepared some pieces of stout card board, and printed on each, in legible letters, a word such as 'Food,' 'Bone,' 'Out,' &c. The head master of one of the deaf and dumb schools kindly agreed to assist me. We each began with a terrier puppy, but neither of us obtained any satisfactory results. My dog, indeed, was lost before I had had him long. I then began training a black poodle, 'Van' by name, kindly given me by my friend, Mr. Nickalls. I commenced by giving the dog food in a saucer, over which I laid the card on which was the word 'Food,' placing also by the side an empty saucer, covered by a plain card. 'Van' soon learned to distinguish between the two, and the next stage was to teach him to bring me the card; this he now does, and hands it to me quite prettily, and I then give him a bone, or a little food, or take him out, according to the card brought. He still brings sometimes a plain card, in which case I point out his error, and he then takes it back and changes it. This, however, does not often happen. Yesterday morning, for instance, 'Van' brought in the card, with 'Food' on it, nine times in succession, selecting it from among other plain cards, though I changed the relative position every time.

"No one who sees him can doubt that he understands the act of bringing the card with the word 'Food' on it as a request for something to eat, and that he distinguishes between it and the plain card. I also believe that he distinguishes, for instance, between the card with the word 'Food' on it and the card with 'Out' on it.

"This, then, seems to open up a method, which may be carried much further, for it is obvious that the cards may be multiplied, and the dog thus enabled to communicate freely with us. I have as yet, I know, made only a very small beginning, and hope to carry the experiment much further, but my object in sending this communication is two-fold. In the first place, I trust that some of the readers of *Nature* may be able and willing to suggest extension and improvement of the idea. Secondly, my spare time is small and liable to many interruptions; animals also, we know, differ greatly from one another. Now, many of your readers have favorite dogs, and I would express a hope that some of them may be disposed to study them in the manner indicated.

"The observations, even though negative, would be interesting; but I confess, I hope that some positive results might follow, which would enable us to obtain a more correct insight into the minds of animals than we have yet acquired."

#### ANTHROPOLOGY.<sup>1</sup>

THE GRAND TRAVERSE REGION.—Dr. M. L. Leach commenced a series of contributions to the *Grand Traverse Herald*, Michigan,

<sup>1</sup> Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

on the 6th of December, having for their subject a history of that particular region. In the first few chapters the Aborigines occupy the prominent place. "Characteristic earthworks are found in Ogemaw county. Mounds are known to exist in Manistee county. Around Boardman lake, near Traverse City, several small mounds formerly existed. Sites of ateliers are frequently discovered, as well as fragments of pottery. The Ottowas were the occupants of this region when it was first visited by the whites. Emmet county was the home of a small tribe called the Mush-quah-tas. They were of Algonquin stock and were a peaceable agricultural tribe. Unfortunately they got into a war with the Ottowas, by whom they were pursued and exterminated without mercy. Dr. Leach reviews at some length the connection of the Jesuits with the savages of this country, especially Father Marquette, and shows the connection of the Ottowas with the conspiracy of Pontiac. Of their military operations subsequently there is little material for solid information. In the 4th chapter the author discusses the social life of the Ottowas. He draws attention to a very important fact, that while in the French and Indian wars these Indians invariably sided with the French, they, in 1812, took sides with the English against us, and exhausted their ingenuity in devising the most shocking barbarities. Again, the adoption of only the bane without the blessing of civilization has made their condition worse rather than better. The houses and industries of the Indians are also described in this chapter. In conclusion we have two words to say respecting these letters. The conception is excellent. Every county should have its historian, and he should not neglect the aboriginal record. Again, this work had better not be undertaken, than to be done imperfectly. There may not be any more to be said about the Indians of Grand Traverse, but Dr. Leach has given us a record all too short.

THE FOLK-LORE OF SHAKESPEARE.—President Welling once wrote to a friend, in vacation, "I have spent my time mostly in reading history and novels, but which is history and which is romance I am at a loss to determine." The works of Shakespeare are plays, and would come under the class of romances; but he has read the great dramatist's writings only superficially who has not discovered on every page the most precious information respecting the life-history of his age. In carefully studying the plays of Shakespeare, in order to gather their folk-lore, Mr. T. F. Thistleton Dyer has performed a task which must have been exceedingly pleasant to himself, and which certainly will form a to permanent contribution to ethnology. We are no less indebted Harper & Brothers for republishing the work in an attractive and cheap edition. As children, we all have wondered how one brain could have originated all the forms that flit before us in these

magic plays. Now, we know that it did no such thing. Shakespeare's fairies, witches, ghosts, and devils were all made for him. How in the world could people have comprehended him, embraced him, loved him, if the atmosphere had been peopled by his wand with unfamiliar creatures. But, when he evolved familiar spirits and gathered around him forms well-known to the vulgar mind, the people bowed down and said: "What manner of man is this whom even our underworld obeys?" The same is true of Shakespeare's love of nature. He was thoroughly scientific. He observed nature; but he also observed how the people looked at nature. In Mr. Dyer's work we are astonished on every page to find references to things which are seen among all the savage tribes of earth, and which had come down to the people of Shakespeare's day as a part of that common legacy of usage, which falls to the lot of all. No man's folk-lore library is complete without this volume.

ESKIMO AND INDIAN PICTOGRAPHS.—Dr. W. J. Hoffman, of the Bureau of Ethnology, has brought his varied talent as artist, physician, and sign-linguist, to bear on the interpretation of the numerous Eskimo pictographs in all our museums. His association with Colonel Mallery in the preparation of his standard work on the sign-language, has rendered Dr. Hoffman not only familiar with signs as generally understood, but he has made good use of his opportunities in learning to converse with the Indian delegations, one after another, when they have been called to Washington. Starting out from the knowledge thus acquired, the author conceives that pictographs on wigwams, blankets, robes, as well as on rocks, wood, and ivory, are synonymous with the gesture-speech of various tribes. He proceeds to illustrate his theory by reading off carved inscriptions from California, Michigan and other red Indian localities, just to test the matter. After that some ten or a dozen elaborate Eskimo carvings are interpreted on the same plan. Nothing is more astonishing than to see a row of men, trees, deer, and huts transformed into "A man came from his settlement to the shaman, and said: 'Should I go a hunting?'" The shaman presented the man with some fire, and went to the top of his lodge, where he invoked the spirits presiding over game. After coming down, he told the hunter that he would kill five deer. Sure enough, the hunter went out, and succeeded as the shaman had predicted." The paper of Dr. Hoffman was first published in the second volume of the Transactions of the Anthropological Society of Washington, and has since appeared in pamphlet form, published by Judd & Detweiler, of Washington.

MEGALITHIC MONUMENTS IN FRANCE.—For many a day it has not been our pleasure to read a more entertaining and exhaustive monograph than that published recently by P. Bézier, in Rennes,

entitled "Inventaire des Monuments Megalithiques du Département d'Ille and Vilaine" [in North-west France]. Published by the Société Archéologique d'Ille-et-Vilaine, 1883, pp. 280, 29 plates, and 2 maps. The plan of the work is as follows: Dolmens, alignments, cromlechs, polishing stones, *pierres à bassins*, rocking stones, to the number of 425 are located and described minutely. This occupies 241 pages, and is followed by a table in which, by number, these megaliths are defined by communes, cantons, and arrondissements. The 29 plates are devoted to illustrating the most prominent and notable of the monuments. The first map locates, by means of the Mortillet and Chantre symbols, every monument in Sixt and St. Just, and the second map, in a general way, indicates the distribution of these works in the entire department above named.

THE ANTHROPOLOGICAL SOCIETY OF LYON.—The first part of Vol. 2 of the Bulletin of this society is at hand. Much of the contents has little interest for us. On page 72 is a short paper on Zulus, illustrated with two plates of arms and utensils. There follows a communication on the *tribulum* among the ancients. A specimen of this implement was on exhibition in the Tunis department at our Centennial Exhibition. It is still in use quite extensively in Northern Africa and Western Asia. On pages 92-107 M. Ernest Chantre describes carefully a necropolis explored by him in Koban (Caucasus). M. Cornivin has for a long time been studying the wormian bones in the face of domestic animals—an abstract is given on page 119.

#### MICROSCOPY AND HISTOLOGY.<sup>1</sup>

COLLODION AS A FIXATIVE FOR MICROSCOPICAL SECTIONS.—Sections fixed by means of a solution of collodion in clove oil, as recommended by Schällibaum<sup>2</sup>, may be colored on the slide. The method is as follows:

The solution which is prepared by dissolving *one part collodion in three or four parts clove oil*, is applied to the slide by means of a fine brush, at the time of using. The sections having been arranged, the slide is warmed for a few minutes (5-10) in the oven of a water-bath, in order to evaporate the clove oil. The sections may next be freed from the imbedding mass, and colored according to desire. If the film of collodion be too thick, cloudiness is likely to arise between the sections. The cloudiness can be removed by the use of a brush, wet with clove oil, after the sections have been anhydriated by absolute alcohol.

<sup>1</sup> Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.

<sup>2</sup> H. Schällibaum, "Ueber ein Verfahren mikroskopische Schnitte auf dem Objectträger zu fixiren und daselbst zu färben." Archiv. f. Mik. Anat. XXII, p. 689, 1883.

Gage<sup>1</sup>, who had begun to experiment with collodion before Schällibaum's method was published, recommends that the collodion and clove oil be applied separately:

"A solution of collodion is prepared by adding to 2 grams of gun cotton (that used by photographers is good) 54<sup>cc</sup> of sulphuric ether and 18<sup>cc</sup> of 95 p. c. alcohol. After the gun cotton is entirely dissolved, the solution should be filtered through filter paper or absorbent cotton. The slides are coated by pouring the collodion on one end, allowing it to flow quickly over the slide and off the other end into the bottle. The prepared slides should be kept free from dust. As the collodion will not deteriorate after drying on the slide, any number of slides may be prepared at the same time. Before using a slide it should be dusted with a camel's hair brush, and with another brush the collodionized surface of the slide should be thinly painted with clove oil.

"\* \* \* The sections are arranged as in the shellac method. The slide is warmed over an alcohol lamp and then heated in a warm chamber so as to drive off the clove oil. After cooling, it may be placed in a wide-mouthed vial of turpentine, chloroform, xylol, or refined *naphtha*, to remove the paraphine. *Naphtha* is very cheap, and is the best agent we have yet tried for dissolving the imbedding mass. The sections are usually freed from imbedding mass within half an hour, though the slide may remain in any of the solvents mentioned for two or three days, or perhaps indefinitely, without loosening the sections. When the slide is removed from the *naphtha*, the sections are washed with 95 p.c. alcohol by means of a medicine-dropper, or by immersing the slide in alcohol. If the sections are to be stained in Kleinenberg's hæmatoxylin or in any other stain containing 50 p.c. or more alcohol, the slide is transferred directly from the alcohol used for rinsing to the staining agent, otherwise it should be first transferred to 50 p.c. alcohol and from that to the staining agent. Whenever the sections are sufficiently stained, they may be mounted in any desired mounting medium. In case Canada balsam is to be used, the slide must be immersed in alcohol to wash away the stain, and finally in 95 p.c. alcohol to completely anhydrate the sections. They are cleared with a mixture of carbolic acid 1 part, turpentine 4 parts. The balsam to be used is prepared by mixing 25 grams of pure Canada balsam with 2<sup>cc</sup> of chloroform and 2<sup>cc</sup> of clove oil. The latter very soon removes any cloudiness that may have appeared in the collodion film."

BORN'S METHOD OF RE-CONSTRUCTING OBJECTS FROM MICROSCOPIC SECTIONS.<sup>2</sup>— Dr. G. Born describes in detail a very ingen-

<sup>1</sup> H. Gage and T. Smith. "Serial Microscopical Sections," *The Medical Student*, p. 14, November, 1883.

<sup>2</sup> G. Born. "Die Plattenmodellirmethode." *Archiv. f. Mik. Anat.* xxii., p. 584, 1883. First described in *Morphol. Jahrbuch* II., p. 578, 1876.

ious method of constructing models of objects from serial sections. By the aid of the camera the outlines of the sections are transferred to wax plates, which are then cut out so as to correspond in outlines as well as dimensions to the sections equally magnified in all three directions. With plates thus prepared, it is only necessary to put them together in the proper order to obtain a complete model. The method is simple and extremely useful, especially in investigating objects with complex internal cavities.

Born has made use of the method in studying different parts of the vertebrate head; Swirski, in elucidating the development of the shoulder-girdle of the pike; Stöhr, in tracing the development of the skull of amphibia and teleostei; and Uskow, in studying the development of the body cavity, the diaphragm, etc.

*An illustration of the method.*—Born makes use of three rectangular tin boxes of equal size, each measuring  $270^{\text{mm}} \times 230^{\text{mm}} \times 2\frac{1}{2}^{\text{mm}}$ . Sections should be made about  $\frac{1}{2}^{\text{mm}}$  thick (never thinner than  $\frac{1}{30}^{\text{mm}}$ ). If we desire to construct a model of an object from serial sections  $\frac{1}{30}^{\text{mm}}$  thick, which shall be magnified 60 diameters, then the wax plates must be made 60 times as thick as the sections, i.e.,  $2^{\text{mm}}$  thick.

The surface of a plate that could be made in a box of the above named dimensions, contains  $62,100 \square^{\text{mm}}$ ; and the volume of such a plate  $2^{\text{mm}}$  thick would therefore be  $124.2^{\text{ccm}}$ . The specific gravity of common raw beeswax amounts to .96-.97. For use, it requires only to be melted and a little turpentine added to make it more flexible. Thus prepared, its specific gravity is about .95; and this number has been found sufficiently accurate in all cases. The weight of the wax required to make one plate of the above size, will accordingly be 117.99 gr., or, in round numbers 118 gr. The wax having been weighed and melted, the tin box is first filled  $1\frac{1}{2}^{\text{cm}}$  deep with boiling water, and then the melted wax poured upon the water. If the water and the wax are quite hot, the wax will generally spread evenly over the surface; if gaps remain, they can be filled out by the aid of a glass slide drawn over the wax. As soon as the plate has stiffened, and while it is still soft, it is well to cut it free from the walls of the tin box, as further cooling of the water and the box might cause it to split. By the time the water becomes tepid, the plate can be removed from the water to some flat support, and left till completely stiffened. Half a hundred plates may thus be prepared in the course of a few hours.

The outlines of the section are transferred to the plate in the following manner: A piece of blue paper is placed on the plate with the blue side turned toward the wax, and above this is placed a sheet of ordinary drawing paper. The outlines are drawn on the latter by the aid of a camera, and at the same time blue outlines are traced on the wax plate. The plate can then be laid on soft

wood and cut out by the aid of a small knife. Thus a drawing and a model of each section are prepared. The plates thus prepared can be put together in the proper order, and fastened by the aid of a hot spatula applied to the edges.

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### SCIENTIFIC NEWS.

—A Scientific Swindler.—A few weeks ago, a man calling himself W. R. Taggart, and claiming to be a member of the Ohio Geological Survey, visited Philadelphia. He called on the principal scientific men of this city, and attended one of the regular meetings of the Academy of Natural Sciences. He seemed to have an extended acquaintance with scientific men, talked very glibly about fossils, and claimed to be writing a report on the *Productidæ*. He is about 5 feet 8 inches in height, weight, 160 pounds, heavy set, heavy featured, light hair, rather deep set eyes; rather shabbily dressed. He had an adroit way of ingratiating himself into the confidence of his intended victims, and then if he could not steal, he would, under some plausible pretext, borrow valuable books or specimens to take to his hotel and forget to return them. His victims are to be found in nearly every important town in the country. In New York, he was E. D. Strong, of Fort Scott, Kansas, and was employed by the Kansas Pacific railway to collect statistics of coal production. In West Philadelphia he gave his name as E. Douglas, of Columbus, Ohio, member of the State Survey. In Auburn, N. Y., he was a deaf mute under the name of E. D. Whitney, U. S. Geologist, Denver, Col. There he obtained a large quantity of valuable geological books and fossils from Professor Starr. In Harrisburg, Chambersburg, Indianapolis, and Columbus, he was a deaf mute. At Indianapolis he swindled the State Geologist out of \$100 worth of rare books, among them Schimper's "*Palæontologie Vegetale*." He has been permitted access to several museums, public and private, from which he has abstracted valuable specimens and sold them. Any information in regard to the real name and residence of this man is much desired.

P. S.—I hear from Professor Lesquereux that he was at Columbus, that he has swindled some parties at Dayton, O. He got hold of valuable Indian relics from the Cleveland Historical Society worth \$50 or more. From Professor Mees, of Athens, O., he borrowed some valuable physical instruments and sold them, &c., &c.—*F. V. H.*

—We reprint with pleasure the following appreciative notice of the late Mr. Robert B. Tolles, optician, of Boston, which appears in the *English Mechanic*: During several years past he devoted himself to the improvement of the microscope, and to the production of telescopes of unusually short focus, and his work

was characterized by great originality and excellence. He was one of the first opticians in America to construct object-glasses for the microscope on Amici's immersion system, and he succeeded in developing several original formulæ by which he extended the apertures far beyond the limit previously attained in either Europe or America. One of the earliest examples of his work seen in this country was a one-sixth water-immersion object-glass, now in the possession of Mr. Frank Crisp, Secretary of the Royal Microscopical Society, and which was the subject of much discussion in journals devoted to microscopy. Mr. Tolles claimed for this object-glass an aperture which was generally regarded as impossibly large. After much controversy he had the satisfaction of receiving the support of Professor G. G. Stokes, Secretary of the Royal Society, Professor S. Newcomb, Director of the Washington Observatory, and Professor E. Abbe, of Jena University, for the general accuracy of his views. He was an enthusiast in his work, and was almost incessantly engaged in making experimental object-glasses both for the microscope and telescope, many of which exhibited rare qualities, and were eagerly sought for by amateurs of fine work. He made the highest power microscope object-glass produced in America, a water-immersion of  $\frac{1}{70}$  in. in focal length. One of his latest and most successful telescopes was a  $5\frac{1}{2}$  in. portable equatorial of very short focus for Professor Hamilton L. Smith, of Hobart College, who has published his trials of the instrument, proving it to be of exceptionally fine quality. The numerous improvements devised by Mr. Tolles in the construction of the microscope have done much to place American optical workmanship on a par with the best in Europe.

— In the March number of the *AMERICAN NATURALIST*, Mr. Titian R. Peale repeats the old account of the Bowditch islanders being ignorant of fire at the time of their discovery in 1841. While Mr. Peale has the advantage of being an eye witness of what he describes, I would call attention to the fact that the story is discredited by ethnologists, and notably by Tylor. It would seem that the members of the Wilkes' expedition had misinterpreted the expressions of astonishment, for Hale, the ethnologist of the same expedition, gives the native word for fire, while the Rev. Mr. Turner, who visited the island a few years later, gives evidence that they had been acquainted with fire for so long a time that the origin of their knowledge had passed into a myth.—*F. S. Kingsley.*

— At a meeting to which the entomologists of Washington and Baltimore were invited, held at the house of Dr. C. V. Riley, in Washington, D. C., on the evening of 29 February, 1884, and presided over by Rev. Dr. John G. Morris, of Baltimore, a resolution was adopted unanimously to establish an entomological society in Washington and vicinity, and a committee was ap-

pointed to draw up the necessary regulations, and to call a future meeting for organization.—*B. Pickman Mann, Secretary.*

—The death of Dr. Hermann Schlegel, director of the Zoölogical Museum of the University of Leyden, is announced. He was born in Saxony. Under his direction the Leyden Museum became one of the most important in Europe, and its collection of skeletons is one of the finest known. It is especially rich in the forms of the Dutch Malaysian colonies. Dr. Schlegel published a number of zoölogical works, among the most important of which are the catalogues of the museum. He was distinguished for his carefulness, and for his extreme conservatism in questions of nomenclature.

—During the past season was founded in Providence the Rhode Island Entomological Society, with Mr. Calder as president, and F. E. Gray, secretary. The society holds monthly meetings.

—Mr. J. L. Wortman has been appointed anatomist of the Army Medical Museum at Washington.

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#### PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON, Feb. 23.—Communications were presented by Elliott Coues on the present state of North American ornithology; by Charles D. Walcott entitled, Further remarks on a rock specimen from Maine, containing corals (with specimen); by Marshall McDonald on natural causes influencing the movements of fish in rivers; and by Lester F. Ward on the diamond willow (with specimen).

NEW YORK ACADEMY OF SCIENCES, Feb. 4.—The following paper was presented: The botany, geology and resources of the country traversed by the Northern Pacific railroad (illustrated with lantern), by John S. Newberry.

Feb. 11.—The following papers were read: Theories in regard to the causes of the recent red skies, by John K. Rees; A memorial notice will be read by the secretary of the late vice-president of the academy, Dr. Benjamin N. Martin.

BOSTON SOCIETY OF NATURAL HISTORY, Feb. 6.—Mr. T. T. Bouvé read a paper on the genesis of the Boston basin and its rock formations; and Professor N. S. Shaler discussed the origin of kames.

Feb. 20.—Dr. T. Sterry Hunt spoke of the Cambrian rocks of North America; and the president described the fossil larvæ from the Triassic rocks of the Connecticut valley.

AMERICAN GEOGRAPHICAL SOCIETY, Feb. 18.—Mr. Albert G. Browne, Jr., delivered a lecture entitled, The growing power of chile, in the Pacific (illustrated with views).

